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BASE METALS BEHAVE LIKE NOBLE METALS in HOLDEN BATHS

AUTOMOTIVE and Aviation INDUSTRIES

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August 1, 1942

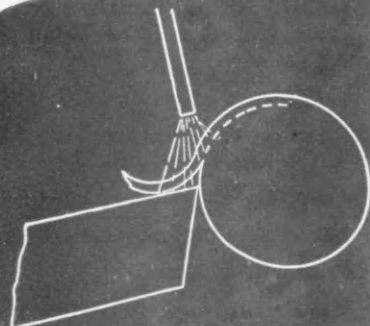
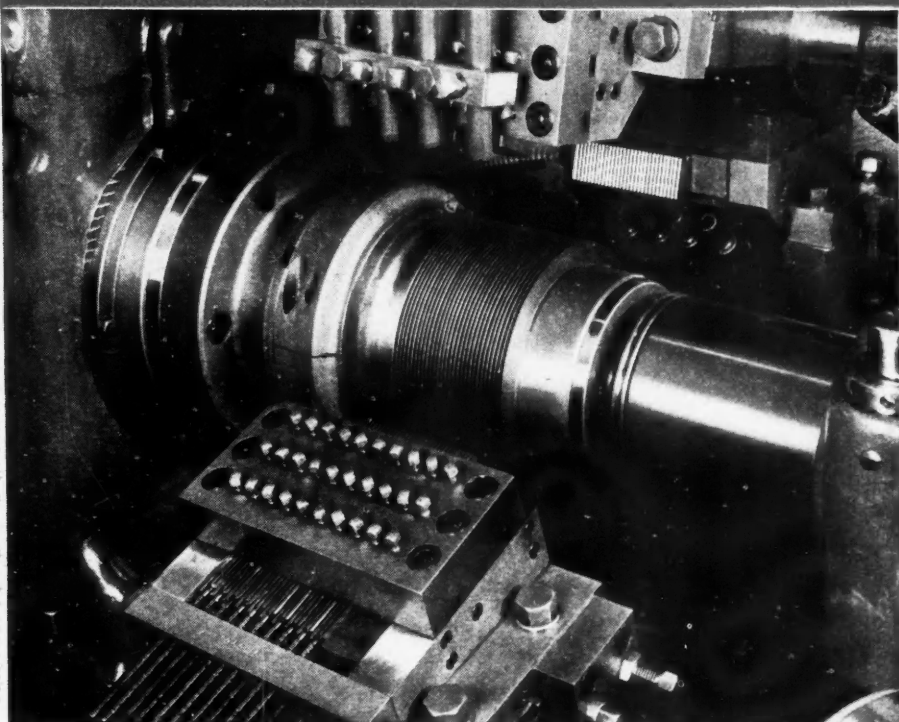
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AUTOMOTIVE and AVIATION INDUSTRIES

Volume 87 Aug. 1, 1942 Number 3

**AUTOMOTIVE
INDUSTRIES**

Reg. U. S. Pat. Off.

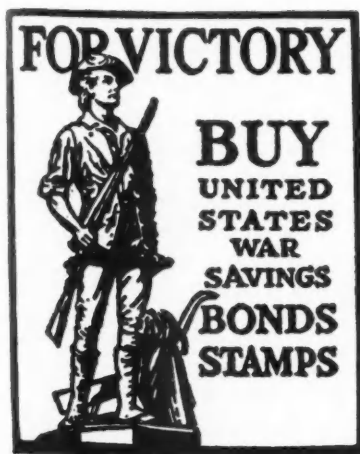
Increase August Tire Allotments

Larger tire and tube quotas for August than July have been allotted to provide for increasing applications by essential vehicle operators for rationing certificates, the Office of Price Administration announced recently.

Passenger car tire quotas for the states and territories total 58,308 new tires for applicants on List A, which includes the most essential services, 87,860 Grade II new tires for a special war worker classification, 637,959 recapped tires or recapping services, and 418,910 inner tubes. July quotas were 57,097 new for List A, 23,402 Grade II, 555,077 recaps and 323,087 tubes.

The quotas for trucks, buses, farm tractors and other heavy vehicles have been increased partly in accord with seasonal pattern, partly in response to evidence of increasing need on the part of eligibles. New tire quota for August is 316,695 against 268,925 for July, while the allotment of recapped tires or recapping services is 355,883 against 314,896, and the tube quota is 347,696 compared with 299,265.

Quota figures are for the states and territories of the United States and do not include the state, regional and national reserves kept for adjustment of emergency situations.



August 1, 1942

Pontiac Concentrates on Oerlikon Anti-aircraft Guns

20

From the manufacture of automobiles to making guns is a big jump. It required a whole new set-up. How Pontiac is equipped for this big job and how the changes were made in record-breaking time is the story told in this the seventy-third of the monthly production features.

Diesel Engine Lubrication

26

Here is a subject that is demanding considerable attention in engineering circles. This brings out the latest developments that have been made in the solving of this problem.

Morale-Building Activities for War Workers

30

With the biggest part of the country's plants on war programs the question of morale becomes a dominant factor in the speeding up of production. What is being done and how it is being done constitutes the material for this most enlightening article.

Alternate Motor Fuels

40

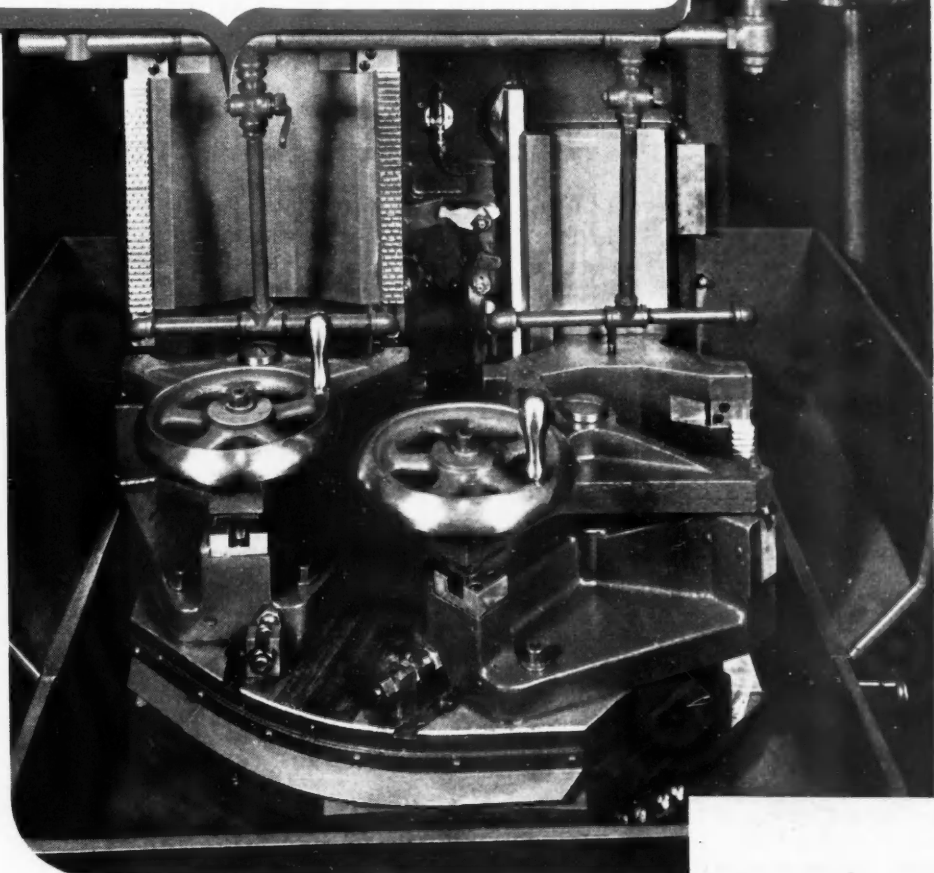
The conservation of gasoline has become a matter of first line importance. When, as and if we in the United States come to the use of substitute fuels the reading of this article now will be of more than passing value. It reviews the developments in this field and shows what is being done and what has been accomplished.

M-4 All-welded Tanks by Fisher

46

That these tanks may come off the production line at the highest possible speed Fisher Body has introduced some innovations in manufacturing technique. Turn now to page 46. You will find it interesting and instructive.

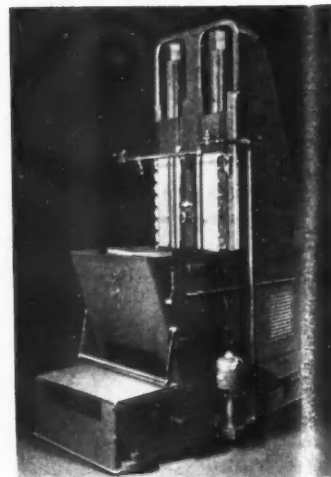
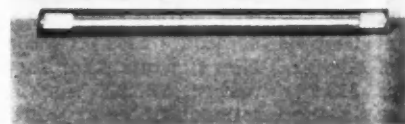
TWO SURFACES 13 INCHES APART BROACHED EACH STROKE OF THE RAMS



MULTIPLE surfaces finished by the broaching method are ordinarily adjacent to each other or close together. However, under certain conditions, broached surfaces may be widely separated, as in the case of the track linkage pins for tanks shown above. These parts have two flats on the diameter 13" apart, $1\frac{1}{4}$ " wide, and $\frac{1}{8}$ " deep. Both flats are broached in one stroke of the ram on the equipment illustrated, a CINCINNATI No. 5-42 Duplex Vertical Hydro-Broach, having two quick clamping fixtures on the table.

This method of surface finishing track linkage pins, engineered by the CINCINNATI Engineering Service Department, produces the parts twice as fast as they could be produced by the obvious method of machining one surface at a time.

A wide variety of parts may be surfaced finished on CINCINNATI Hydro-Broach Machines at rapid production rates. Many of them are illustrated in our brochure "*How to Step Up Production With Cincinnati Hydro-Broach Machines*". You may obtain a copy of this publication at no obligation whatever.



● CINCINNATI No. 5-42 Vertical Duplex Hydro-Broach Machine. Exclusive swivel table and two alternately cutting broaching tools give you continuous production. See our insert in Sweet's catalog file for mechanical industries, or write for catalog M-894.

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st
and 15th of the month

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August 1, 1942



It Still Takes Repair Parts and Tires to Keep Cars on the Road

By James R. Custer

HOW vital motor transportation is in the economy of this nation becomes more and more substantiated as the rubber and gasoline shortages continue to disrupt it while axe-grinding and ambitious political and bureaucratic elements in Washington prove themselves incapable of formulating a feasible program. And its importance is evidenced further by the fact that in the past 95 per cent of the passenger cars have been used partly or wholly for necessity trips. The unquestionable objective then should be to keep the needed number of vehicles operating in essential mileage rather than to have them removed from the road because of utterly confused official thinking and chaos-creating action with respect to providing the necessary materials. If ever a great national problem called for simon-pure scientific investigation and logically coordinated handling, this is it.

Although rubber and gasoline are immediate problems, the supply and distribution of replacement parts

loom as an ominous threat and in the near future they will be in the critical state unless something is done to prevent it. Already there have been tie-ups of trucks due to the necessary parts not being available for repair work. Shortages now exist in parts made of chromium and nickel alloys, and from heavy forgings. Another factor is the idle replacement part tools at plants concentrating on war work, a condition that also results from the lack of metals. Inadequate transportation facilities also have contributed to shortages of parts in some sections, particularly on the West Coast.

At war plants various types of vehicles, including hearses in certain instances, are being pressed into service for transporting workers. Many of them were not designed for the kind of service in which they are

being used and are being subjected to longer periods of daily service and heavier loads than those for which they were intended. These are a few reasons; there are many others why a definite program should be set up to assure an adequate supply of repair parts and a workable system for their distribution.

Heretofore, functional replacement parts have been given A-10 preference ratings, but recently the War Production Board adopted the policy of assigning them ratings "up to A-1-a," depending upon their relative importance at the time. Those for military vehicles naturally receive the higher ratings. There is no fixed preference rating for any particular part, but even with the new classification "up to A-1-a," their relative position in the priority system is said to be not much better, if any, than formerly as more preference ratings to benefit war materiel have been superimposed above A-1-a, which originally was the first of the priority ratings when replacement parts were given the A-10 rating. Now as then, the limited supplies of alloy steels and other metals remain the controlling factors.

Tire Manufacturers' Plan

Realizing the urgency of the rubber situation, tire manufacturers began an exhaustive study and have developed a concrete plan to provide sufficient tires and recaps for all civilian passenger cars during a two-year period starting July 1, 1942. It is based upon 40 per cent less car mileage than in 1941, a maximum speed of 40 m.p.h. and regular monthly inspections.

The plan, which is being sponsored by the Rubber Manufacturers Association and has been presented to

Tire Manufacturers' Estimate of Tires and Recaps Required to Keep All Civilian Passenger Cars Running

	July 1, 1942	July 1, 1943
	July 1, 1943	July 1, 1944
New Tires	4,796,000	8,427,000
Recaps	10,688,000*	19,603,000*
From present frozen inventory of 8,500,000 tires	2,330,000	2,330,000
Total Units	17,814,000	30,360,000

* Field recapping capacity sufficient to handle first year requirements. Any excess the second year will be recapped in original molds at factories.

Requirements for New Tires and Recaps (Long Tons)

	July 1, 1942	July 1, 1943
	July 1, 1943	July 1, 1944
Reclaimed Rubber	48,769	48,651
Thiokol	10,688	22,500
Butyl (Flexon)	2,475	30,000
Natural Rubber	1,189	2,143

the proper Government officials for their consideration, estimates that 30,291,000 recaps, 13,233,000 new tires and 4,666,000 of the pre-war tires now frozen under existing tire regulations will take care of passenger car requirements during the two-year period. For new tires the life would be about 10,000 miles and

for recaps about 7000 miles. Further production of tubes is considered unnecessary unless an unbalanced size condition occurs, since there are an estimated 10,000,000 pre-war tubes in inventory and tubes now in use can be repaired. Recapping would not require additional equipment, for if the demand became too great for field recapping plants to handle, the work could be done in the original tire molds at the factories.

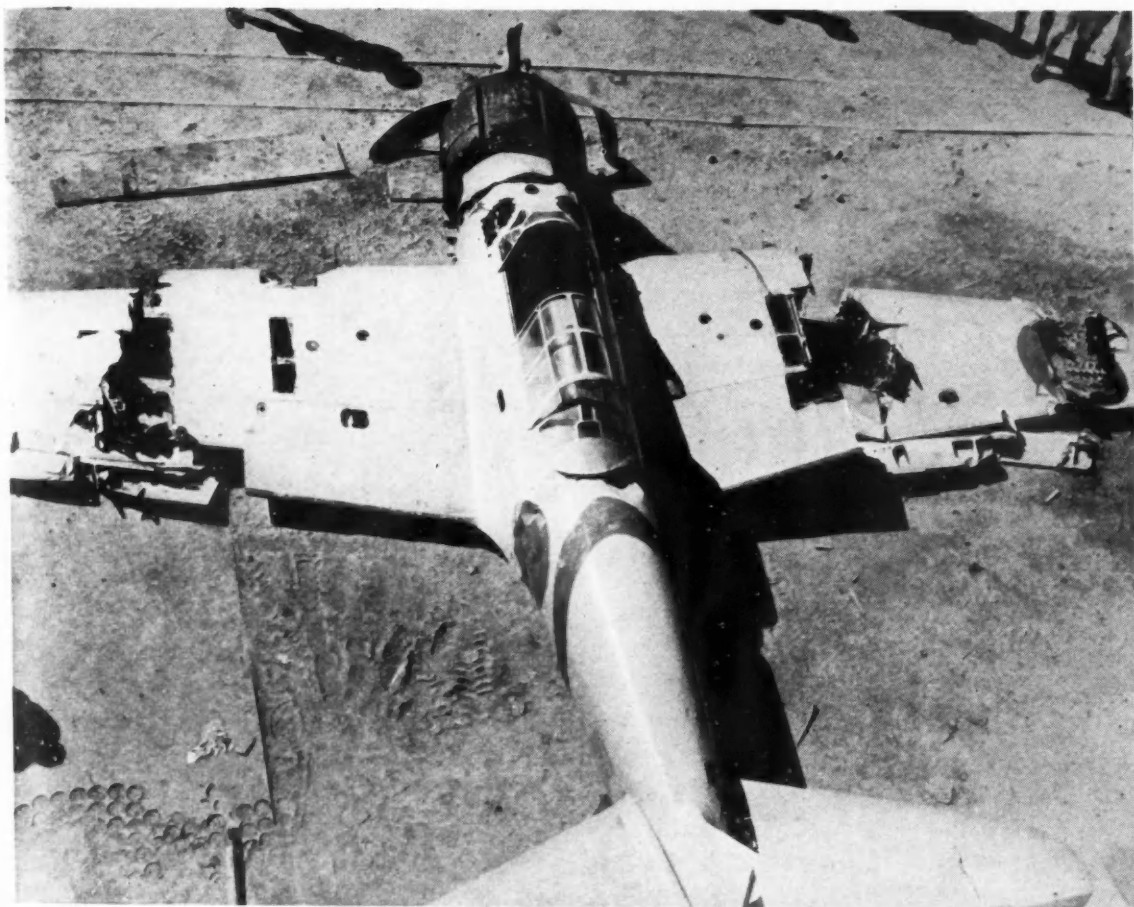
Raw materials required for the recaps and new tires during the two years are estimated by the originators of the plan at 97,420 long tons of reclaimed rubber, 3332 long tons of natural rubber, 33,188 long tons of Thiokol and 32,475 tons of Butyl. The plan was formulated on the basis it would leave for military and non-tire civilian requirements nearly all of the crude rubber stockpile, over 85 per cent of the reclaimed rubber capacity, all projected Buna S and Neoprene capacity, and a portion of the Thiokol and Butyl production.

The above tonnages were developed on the assumption that 75 per cent of anticipated Thiokol and Butyl produc-

(Turn to page 62, please)



Passenger cars are needed for many essential uses and to show how they can be provided with tires or recaps in addition to military needs, tire manufacturers presented a factual exhibit in Washington. Representatives of the larger tires companies included (left to right) P. W. Litchfield, Goodyear president and chairman of the board of directors of the Rubber Manufacturers Association; William O'Neil, General Tire president; Harvey S. Firestone, Firestone president; J. J. Newman, B. F. Goodrich vice-president; L. D. Tompkins, U. S. Rubber vice-president; and J. P. Seiberling, Seiberling president. They are standing in front of the recapping display.



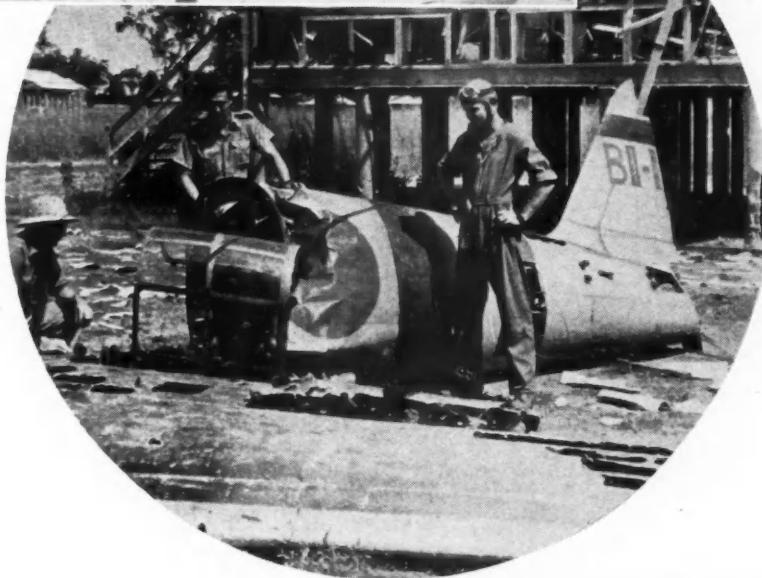
Press Assoc. Photo

JAP Zero Fighter

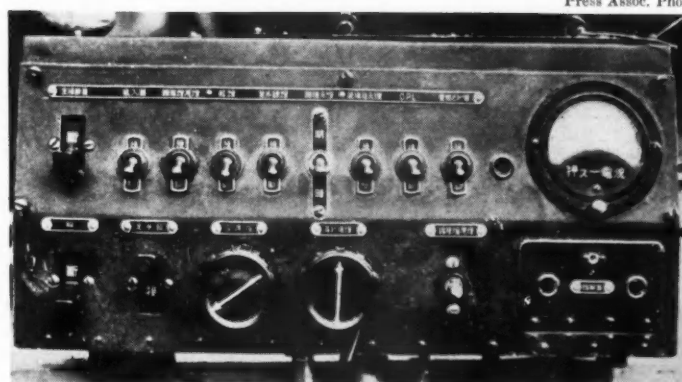
THE MITSUBISHI 00 fighter, better known as the Zero, derives its name from the Japanese custom of designating planes according to the last two digits of the year in which the design was begun—here, the year 2600 of the Japanese Empire (1940). The plane shown in the top photograph is a metal-covered model which was shot down in the Australian theater. Note the constructional details shown in the circle, and the simplified instrument panel at the bottom.

The Zero has been variously described—first, as a fabric-covered, and then as a metal covered fighter driven by a Nakajima NK-1 14-cylinder, twin-row, air-cooled radial (resembling a similar Pratt & Whitney engine) delivering 1100 hp for

(Turn to page 70, please)



Aeme Photo



Press Assoc. Photo

By Joseph Geschelin

Pontiac Concentrates on 0

*This is the Seventy-third
in the series of monthly
production features*



(Above) George Gorton engraving machine with pantograph attachment is used for cutting various identification markings on the barrel and other parts.

(Right) One of a number of grinding cylindrical operations on the barrel—employing Landis, Norton, and Cincinnati grinders.



THE OERLIKON rapid-fire 20-mm. anti-aircraft gun, America's answer to the menace of dive bombers over the seas, is now coming off the assembly lines of the Pontiac Motor Div., General Motors Corp., plants. The Oerlikon mounted on the decks of ships of our convoys will do much to assure uninterrupted sea lanes, will help the U. S. Navy to transport the weapons of war to the democracies overseas.

In the early stages of negotiations, Pontiac accepted the existing design, worked feverishly to put the job into production with the greatest dispatch. Speed was achieved by taking full advantage of sub-contracting as is evidenced by the fact that Pontiac fabricates only 22 of the major parts whereas about 170 smaller com-

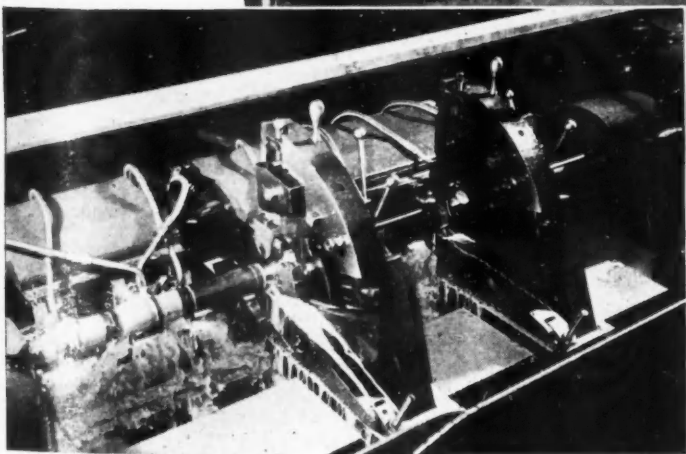
ponents are produced by other scattered concerns.

This operation, too, exemplifies a special case of "conversion" to war production since there is little similarity between the making of passenger cars and the making of the Oerlikon gun. Analysis of the gun job indicates that about 85 per cent of all metal cutting operations are done on milling machines, the rest of the work being distributed among drill presses, grinders, and special boring, reaming, rifle-drilling, and rifling machinery. Because of the emphasis upon milling operations very little equipment could be sal-

Oerlikon Anti-aircraft Guns



(Above) The Gun—scourge of dive bombers.



(Left) Close-up of Lo-Swing lathe operation on the gun barrel. Note the steady rests and multiple-cutting tools tipped with Carboloy.

vaged from the passenger car side of the slate. Actually only about 12 per cent of the equipment in the Oerlikon division is represented by machinery shifted from passenger car departments.

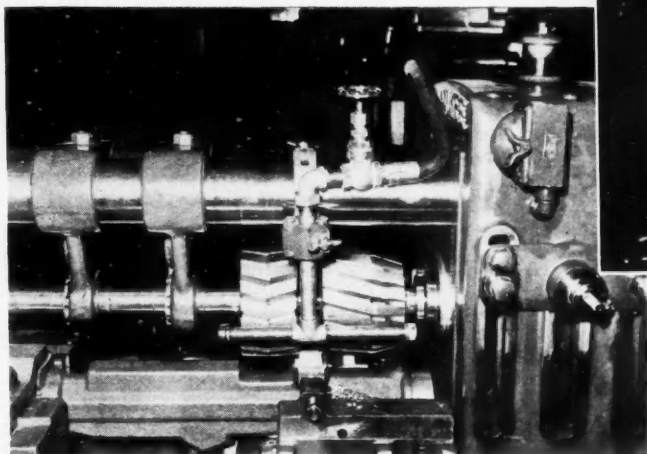
Some appreciation of the metal cutting problem may be gained from a study of the metal removal on some of the major parts. Consider the breech case, the largest single element of the gun. The rough forging weighs 170 lb. When finished, the breech case weighs but 41 lb. The gun barrel is received as a rough-turned forging weighing 88 lb.; when finished it is whittled

down to 37 lb. The recoil spring case is a solid forging weighing some 56 lb. which is brought down to but 6 lb. The breech bar comes in at 19 lb. and is machined down to but 7½ lb. The hand grip forging weighs 14½ lb. and is trimmed down to only 3.87 lb.

When it becomes necessary to remove from 50 per cent to 80 per cent of the weight of parts by sheer metal removal, there is a tremendous problem of machine time and equipment—a lot of equipment—and cost. But of these elements the most important is Time. Accordingly, Pontiac is devoting its energies—in cooperation with the ordnance division of the Navy Department—to two major aspects of the situation: the development of unique methods designed to speed

(Right) An example of heavy profile or form milling on a heavy duty Cincinnati milling machine. This setup features the use of massive indexing fixtures, holding two breech casings at a time.

(Below) Close-up of one of the heavy profile-milling operations on the breech casing, this one set up on a Milwaukee mill of heavy duty type.



up metal removal; and, simultaneously, the redesign of certain components in such fashion as to further reduce metal removal. Before long the combination of these will result in a greatly accelerated tempo of production volume from the same facilities.

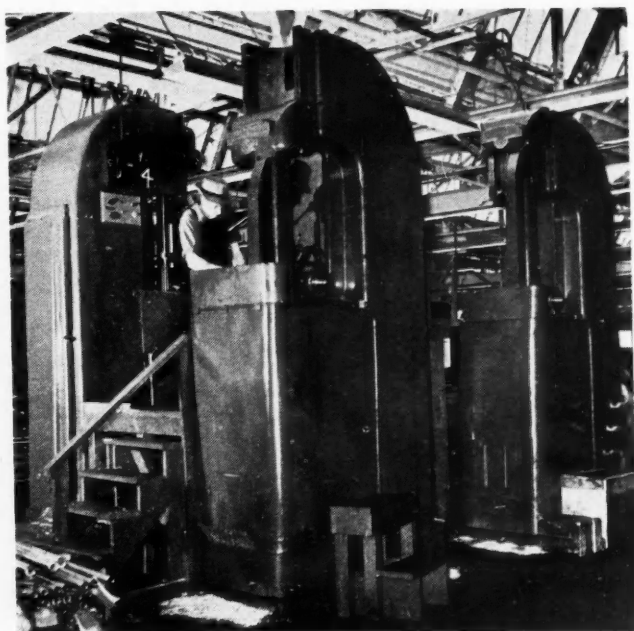
Coming to the details of machining operations, it

is of interest to find that most of the milling job is done on the latest types of heavy-duty Cincinnati milling machines and Cincinnati Hydromatics; and on the modern heavy-duty Kearney & Trecker mills of various types. At the present time, many of the milling machines are being converted to automatic operation by the installation of hydraulic or electric tracer arm mechanism. To speed up the effectiveness of these high production mills wherever possible the machine is provided with massive indexing fixtures holding two or more pieces at a time.

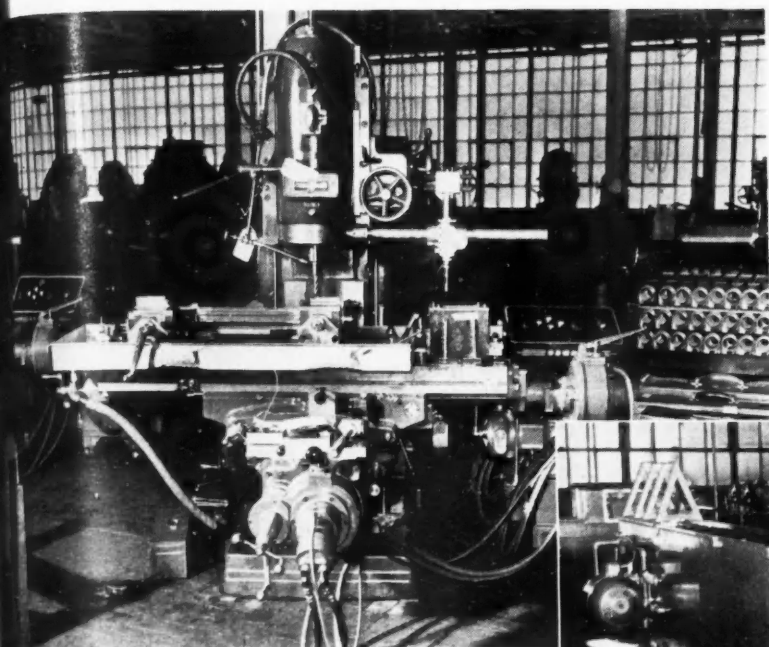
In some instances, one piece is handled in two different settings on the indexing fixture; in other cases, two pieces have the same operation performed simultaneously. In any event, the mass production "know-how" of the Pontiac organization has strained every resource to break down operations to the finest detail so that each specialized set-up performs its share of the task. Consequently, we find a great multiplicity of machines and operations, the final integration of which results in the maximum of productivity and economy.

Other familiar types of machinery have been introduced to speed up productivity and, in some instances, to provide a more advanced method of doing the job. The latter is true of the W. F. & John Barnes horizontal machines for rifle-drilling and for boring the breech case; the Barnes Drill horizontal honing machine for the breech casing and barrel bores; the vertical six-spindle W. F. & John Barnes for rifle drilling the barrels and 8-spindle vertical machines of the same make for reaming the barrels; the 14-spindle vertical Kreuger machine for producing the intricate chambering; and the horizontal American Broach & Machine Co., unit for doing the barrel rifling.

Among the other familiar types of machines are the following: W & S turret lathes; Heald internal grinders; Thompson surface grinders; special Natco multiple-drilling machines; Cincinnati-Bickford drills; Landis and Norton grinders; Ex-Cell-O precision

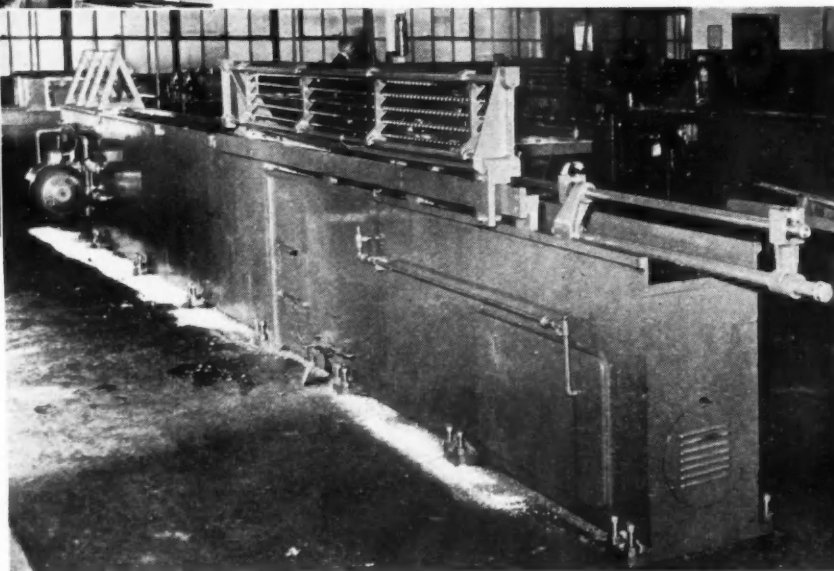


(Bottom) Part of a battery of huge Cleveland Rigidhobbers for cutting the cooling fins on the outside of the gun barrel. This operation formerly was performed on milling machines.



(Left) Typical of the milling machine being equipped with an automatic profiling attachment is this Cincinnati vertical machine.

(Below) American Broach & Machine Co., horizontal broaching machine now utilized to speed the process of rifling the barrel. Four long broaching tools are employed, the first one keyed to the lead screw attachment, the others arranged to follow the path of the first tool.



thread grinders of internal and external types; Lo-Swing automatic lathes tooled with Carboloy for turning barrels; Cleveland Rigidhobbers for cutting the long barrel grooves; Monarch lathes; George Gorton engraving machines; heavy-duty Baker drill presses; abrasive grinders; versatile Bridgeport Machines millers; Cincinnati Hydro-Tels; Pratt & Whitney 6 in. vertical shapers; Cone automatic; Edlund drills; Heald Size-Matics; and a converted six-spindle Pratt & Whitney vertical rifle-drilling machine formerly used for rifle-drilling connecting rods.

Although the manufacture of this fine gun is made so complicated because of heavy metal removal, this is further intensified by the need for maintaining extremely fine tolerances on most dimensions. To cite but one example, the interrupted grooving in the breech case and on the barrel end is held to 0.008 in. tolerance for spacing from groove to groove; and 0.008 in. on the overall spacing. The concentricity of the various bores in the barrel is held to 0.0025 in. In general, the milling operations are held to a tolerance of 0.001 to 0.004 in. depending upon operating conditions. Some small diameter holes are held as close as 0.00011 in.

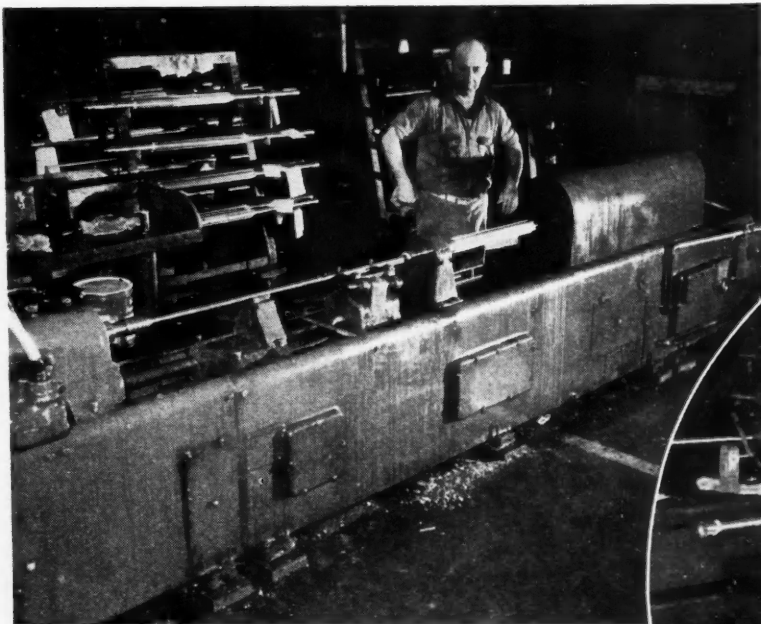
Most of the materials handling in this division is accomplished with the use of Yale & Towne industrial trucks of various types.

Consider now some high spots of machining operations. The breech casing is by all odds the biggest metal cutting job in the set-up, includes a total of some 240 individual operations. Without going too much into the detail, it may be noted that the bulk of the operations are handled on milling machines including—Kearney & Trecker horizontal and vertical mills; Milwaukee Simplex mills; Cincinnati vertical, horizontal, Duplex, and Hydromatic mills. Among the

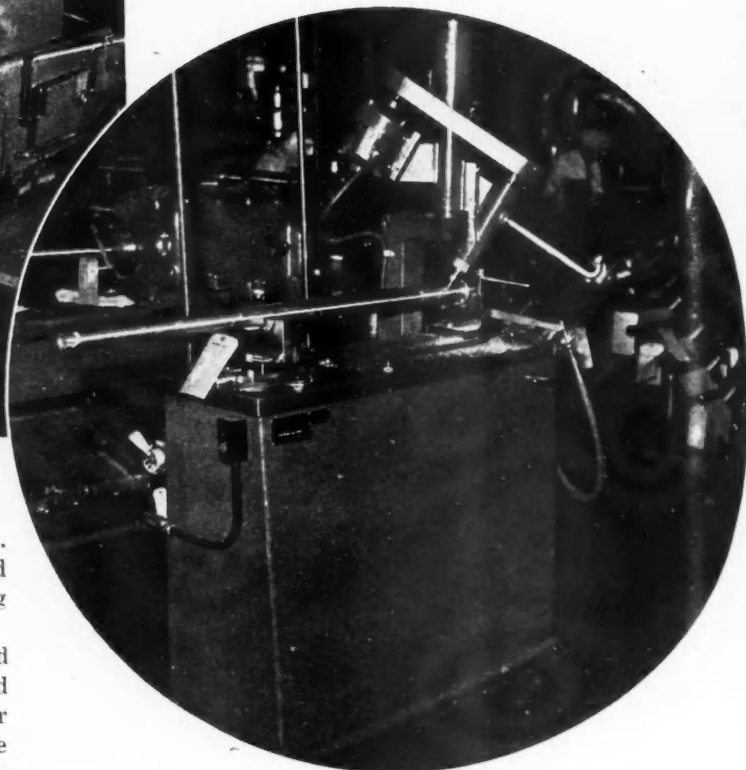
innovations in this connection are some ACCO Bremae milling machines with automatic feed, arranged for heavy-climb milling operations. Straddle-Milling is



Most progressive method of chambering gun barrels is provided by this 14-spindle Kreuger machine, arranged for an automatic cycle.



Barnes Drill Co. horizontal honing machine employed for the honing of the barrel bore.



(Circle) An example of automotive ingenuity is this simple machine devised for rounding the ends of annular locking rings on the barrel.

employed wherever possible to speed up the process. And there are many examples of form milling and delicate form-blending operations with end milling cutters.

Here will be found some Sundstrand double-end centering machines; Cincinnati grinders; facing and turning on Monarch lathes; rifle-drilling the center hole on 48 in. W. F. & J. Barnes horizontal two-spindle drilling machines; facing and shouldering the ends on American and Reed-Prentice lathes; grinding end diameters on Landis grinders; core-drilling and line-boring on another battery of horizontal W. F. & John Barnes machines. The final line-boring operation is finished by honing in a horizontal Barnes Drill honing machine fitted with a Micromatic honing tool.

End diameters of the breech casing are ground in a 72-AS Heald grinder, the ends being ground on a 14 by 48 in. Landis grinder. Sides and bottom of feet are ground in a Thompson surface grinder. The 12 holes in the front end present an unusual problem since they have to be drilled accurately to a depth of 10½ in. with close tolerance on the spacing and thickness of wall section. These holes are drilled in three indexing operations in a special Natco drill fitted with four spindles. After drilling, the holes are flat-bottomed in a Cincinnati-Bickford, reamed in another Natco. The front end bore is bored out on a Gisholt turret lathe. Two diameters on the rear end are ground in a 16 x 18 in. Norton grinder.

As the finishing operations progress, the breech casing assumes the final form in which most of the metal has been removed and the part has been formed to its intricate contours inside and out. One of the fussy operations is the development of the dovetail on K & T vertical mills. The sides of the dovetail are finished on a 30 deg. angle, holding the height of the dovetail to plus 0.000 in., minus 0.0039 in., while the angular sides are held so as to check accurately with rolls 0.2362 in. in diameter plus or minus 0.0002 in. A Cincinnati Hydromatic finish-form-mills the right and left

hand sides on the front end holding the diameter to 3.6535-3.6613 in. George Gorton engraving machines are employed for engraving various symbols.

The foregoing is but a small sampling of the total of 240 operations required to produce the breech casing. Now consider the barrel. This is received in rough turned condition, then is cut to rough length on a DeVlieg mill. First major operation consists of cutting two steady rest spots, on Landis grinders, for the lathe operations. Next major operation is that of rough-turning the large diameter and taper in a Lo-Swing automatic lathe, using Carboloy tools. The barrel is rifle-drilled by two methods—the familiar P & W horizontal ordnance gun drill; and the newly installed 6-spindle W. F. & John Barnes vertical rifle-drilling machine. It is reamed in three operations, using a horizontal P & W reaming machine for semi-ream. The latest development is the introduction of the 8-spindle W. F. & John Barnes vertical reaming machine which greatly speeds up the operation.

The reamed bore is honed in the big horizontal Barnes Drill honing machine. The diameter at the breech end is finish-turned in a Lo-Swing automatic lathe, the spline diameter ground on a Landis grinder, finish-turned at the muzzle end on a Lo-Swing lathe.

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Acetylene Generators

Save Swiss Cars



Carbor acetylene gas generator, built by General Motors Suisse, installed on a Chevrolet car in Switzerland.

SUBSTITUTE fuels continue to occupy the attention of motorists and automobile engineers in most of the European countries. Although Switzerland is not a belligerent, it suffers as much from the shortage of motor gasoline as any of the countries actually in the struggle, for it has few sources of possible substitute fuels. Fortunately there is plenty of water power in the country, and this may explain why attempts are now being made to use acetylene produced from calcium carbide. The use of acetylene for this purpose was suggested during the infancy of the automobile, and *The Horseless Age* as far back as June 20, 1900, issued a special Acetylene Motor Number. It was found, however, that because of its low ignition temperature, the gas formed a highly detonating mixture, and the acetylene motor did not get beyond the experimental stage at the time. Since then, of course, a good deal has been learned about detonation control.

Acetylene generators for use with motor-vehicle engines are now being marketed in the various countries. They may be divided into two classes—automatic and hand-controlled—and they can be classified also according to the method

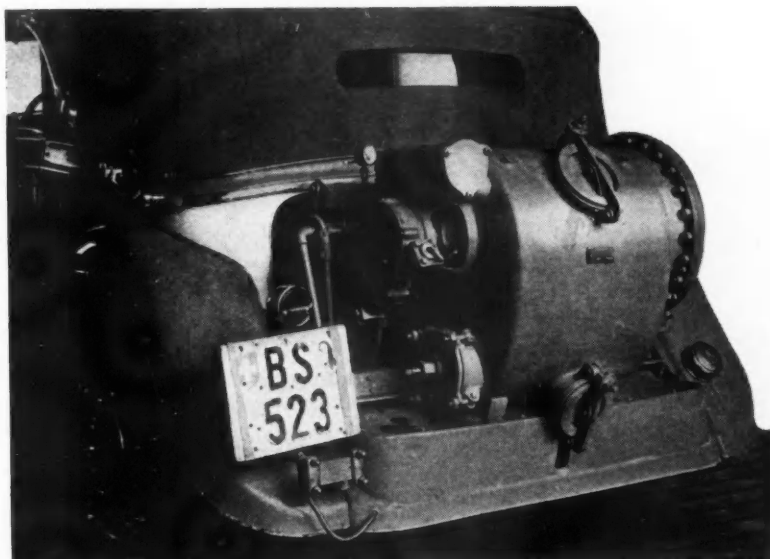
of feed into carbide-to-water and water-to-carbide generators. Seven different equipments are on the market in Switzerland, and all of them are comparatively light and neat.

A particularly attractive equipment, known as the Carbor, was developed by General Motors Suisse. It comprises a long cylinder which can be readily fitted to the front of the car and is so fitted to the Chevrolet, of which a photograph is shown here. The cylinder is divided into five compartments, which are filled with calcium carbide. Water is carried in the gasoline tank at the rear of the car to the generator by the regular fuel pump, but the actual delivery of the water to the carbide chambers is by drip feed. The amount of calcium carbide which can be carried in the generator is equivalent to about 6 gals. of gasoline.

Owing to the highly detonating quality of acetylene, in Switzerland it is used in combination with methyl alcohol, which has strong anti-detonating qualities. In France, on the other hand, ammonia gas is used as anti-detonant, the mixture consisting of 78 per cent acetylene and 22 per cent ammonia.

With acetylene as the motor fuel in automobiles, the maximum speed of the car is reduced by about 10 per cent, but the engine can be started instantly and acceleration is just about as good as with gasoline. A chemically correct mixture of acetylene and air con-

(Turn to page 72, please)



Mercedes-Benz car equipped with a Buss generator.

Courtesy of The Motor (London)

Diesel

FROM the frequency with which Diesel lubrication has been discussed at engineering meetings in recent years it is quite evident that the lubrication systems of these engines have presented various involved problems. Since the average operating temperature of the Diesel cycle is lower than that of the Otto cycle, one might expect less difficulty in lubricating Diesel engines than gasoline engines. However, maximum gas pressures are higher in the Diesel, and with the same piston displacement the inertia loads are greater, because reciprocating parts must be made somewhat heavier. Another difference is due to the effect of the fuel used on the lubricant. In a gasoline engine the crankcase oil usually is diluted with unvaporized fuel, in the course of operation, so that its viscosity decreases. In a Diesel, on the other hand, the oil usually gains in viscosity, due chiefly to oxidation. Quite naturally, there

is a greater tendency to carbon deposits and to the formation of gums and varnish

with a very viscous, sluggish oil than with one of low viscosity. Lubrication troubles with Diesel engines have been most pronounced where the specific output is high, due either to high speeds or the use of the two-stroke cycle, and where the cylinders are relatively large. In at least two cases the manufacturers have had special oils developed for their engines and insist on the use of these oils by operators.

In the past, representatives of oil companies frequently have been heard on the Diesel lubrication problem. Among those most intimately concerned, besides the engine manufacturers, are the manufacturers of such parts as pistons, rings, and bearings, and at a symposium held on the subject at the recent A.S.M.E.-S.A.E. National Oil and Gas Power Conference, all of the contributions were by representatives of engine and parts manufacturers.

Fundamentally there are only two requirements which a Diesel engine lubrication system must meet—that all of the wearing parts be effectively lubricated under all operating conditions and that the oil consumption be not excessive. Lubrication troubles, however, are of several different kinds. There may be excessive carbon formation, which interferes with heat flow, chokes the ports, and generally impairs the operating conditions; the pistons or piston rings may scuff or score, the rings may stick in their grooves, which prevents them from performing their function of sealing the combustion chamber, and the pistons may seize in the cylinder. It is noteworthy that practically all of these ill effects occur in the cylinders. Bearing lubrication also has given rise to some difficulties in the past, but they are now usually guarded against by the use of special bearing metals and hardened journals, which permit higher bearing loadings.

In the development of a new Diesel engine the lubrication problem is dealt with successively by the

designers, the experimental or testing staff, and the service department. It is up to the designer to provide a design that if properly carried out will ensure efficient lubrication and will not result in excessive oil consumption. Most designers of high-speed Diesel engines have had previous experience with similar gasoline engines and can be guided by it to quite an extent. It is generally known, for instance, that one of the chief causes of excessive oil consumption is cylinder distortion, and this subject was dealt with in the paper contributed by A. T. Stahl, of Mack Manufacturing Corp. He divided cylinder distortion into fixed and variable distortion. The fixed distortion is

traceable chiefly to improper stud loading, insufficient deck rigidity, or faulty relations between cylinder deck, cylinder bore and stud bosses. An interesting point regarding a certain type of distortion was made by W. M.

McLaurin, of Guiberson Diesel Engine Co., who said that Guiberson shrinks the cylinder heads onto the barrels and this shrinking operation produces a nominal contraction of 0.011 in. at the top of the barrel. This shrinking operation produces a certain out-of-roundness in the barrel. In 90 per cent of the production this out-of-roundness is limited to 0.005 in., and this produces no noticeable effects on cylinder-wear distribution, piston-ring operation, blow-by, and oil consumption. Measurements, of course, are made at room temperature, and at operating temperatures the distortion may be materially greater.

The "variable distortion," Mr. Stahl said, is dependent chiefly on the water circulation in the jackets and on the form of the combustion chamber. He felt that in view of the lack of knowledge of the path followed by the water through the jackets of a multi-cylinder engine, no attempt should be made to direct the entering water at the barrel; the designer should merely see to it that the greatest possible area is exposed to water cooling and that the cooled areas are simple and symmetrical in shape. As regards the effects of combustion chamber form, there are two general types of Diesel engine, those in which the combustion chamber is open to the cylinder and those in which it is more or less separated therefrom, as in the air-cell or precombustion-chamber type. The latter has the advantage that the pressure rise in the cylinder is less severe, but the temperature distribution in the cylinder head is not always symmetrical around the axis, and this may give rise to cylinder distortion.

The effect of smoothness of cylinder-bore finish on oil consumption and other characteristics was touched on by Mr. McLaurin. He said that the cylinder sleeve of the Guiberson engine is finished to 6-10 micro-inches. If the surface finish is below 6 micro-inches there is a notable increase in oil consumption, while if it is 15 micro-inches the oil consumption is not affected but

By P. M. Heldt

Engine Lubrication

the running-in process takes a longer period of time.

It is generally known that in automobile operation the oil consumption per unit of distance traveled increases rapidly with the speed. When engines are considered by themselves, the oil consumption usually is given on the hourly basis, or on the basis of brake horsepower-hours. On whatever basis it is given, the consumption generally increases rapidly with the speed. Three of the contributors to the symposium gave figures of oil consumption at different engine speeds. Mr. McLaurin stated that his firm's nine-cylinder radial 1020-cu. in. engine, which is rated 250 hp. at 2200 r.p.m., consumes 0.009 lb. per bhp.-hr. at 1800 r.p.m., 0.013 lb. at 2000 r.p.m., and 0.020 lb. at 2200 r.p.m. From these figures it can be deduced that the specific oil consumption varies roughly as the fourth power of the speed. A. T. Stahl gave total oil-consumption figures for an engine at 2000 and 2400 r.p.m. respectively, with four different sets of oil-control equipment. The proportional increase in the rate of oil consumption with an increase in speed from 2000 to 2400 r.p.m. was substantially the same with all four equipments, averaging 314 per cent. This indicates that the total consumption varies as the 6.3 power of the speed. On a horsepower-hour basis, the rate of increase naturally would be lower, for the engine power is greater at 2400 than at 2000 r.p.m. The results therefore are not incompatible with those given by Mr. McLaurin. Quite different in their implications are the oil consumption figures given by F. Glenn Shoemaker and Rex Allbright for a General Motors two-stroke Diesel engine with a certain arrangement of piston rings. This engine produced 2870 bhp.-hr. per gallon of oil at 1200 r.p.m., 3270 at 2000 r.p.m., and 3040 at 2200 r.p.m. Assuming the oil to weigh 7.2 lb. per gal., these figures correspond to 0.0025, 0.0022 and 0.00237 lb. per bhp.-hr. In this case, therefore, the oil consumption is substantially independent of the speed, and it even decreases through the speed range 1200-2000 r.p.m.

In a two-stroke engine the cylinder-lubricating

problem is different from that in a four-stroke in several respects. In the two-stroke there are inlet ports at the lower end of the combustion chamber, and this part of the cylinder is surrounded by an air chamber containing air under pressure (from the blower). Care must be taken that no excessive amount of oil gets up to the ports in the cylinder walls, as if it does, carbon deposits will build up rapidly and interfere with the proper action of the ports. In a two-stroke engine it is therefore necessary to locate the oil control ring at the lower or open end of the piston, so that even with the piston at the top of the stroke, these rings are below the ports. In such an engine, moreover, the oil control rings are assisted in their work by the leakage of air from the air chamber past them. There is a considerable pressure difference between the air chamber and the crankcase and there is therefore a continuous flow of air past the oil rings into the crankcase.

In addition to reducing the amount of oil which the rings must control, this air flow has the effect of keeping the oil passages in the control rings clear. This air flow may be one of the reasons for the slight influence of engine speed on the specific consumption. Another factor may be the high radial pressure of the oil control rings, which is said to be of the order of 200 to 300 psi. Such high ring pressures, of course, can be obtained only with composite rings com-

prising steel springs. The oil control rings actually used consist of two sections and a steel expander. This ring construction affords a large oil-return passage and is to a certain extent self-cleaning, owing to relative motion between the two sections. The three-piece rings can be installed in the groove with the scraping hooks on both sections down, in which case the control action is the most effective, or with the scraping hook on the lower section turned up.

Another thing essential in a two-stroke engine of this type is that the piston-pin holes be plugged so that no oil can work through them to flood the piston skirt. The compression rings at the upper end of the piston must carry their lubricant with them, and in

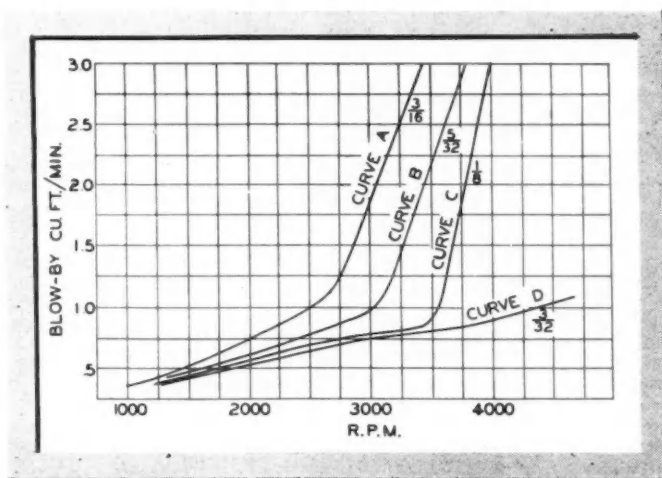


Fig. 1—Variation of blow-by with speed, for different ring widths.

order that they may be able to do so their surfaces should not be too smooth. The rings are tin-plated on their bearing surfaces. The tin has a lubricating effect, and if any part of the bearing surface is overheated in service, the self-healing property of the tin coating comes into play.

In discussing the engineering of piston rings for high-speed Diesels, Paul S. Lane of Muskegon Piston Ring Co. and Stuart Nixon of Sealed Power Corp. said the trend in recent years has been toward narrower rings. Widths of rings for high-speed Diesels with bores of 3½ to 10 in. range from 1/35 to 1/65 of the bore. Advantages of the narrow rings were said to include a reduction in wear on the sides of the lands due to lower ring inertia, reduced wear of both the cylinder bore and the rings, a reduction in the piston length occupied by rings, decreased friction, and better sealing action. Moreover, the speed at which ring flutter sets in is raised and may be carried beyond the maximum operating speed, as is shown by Fig. 1, in which the rate of blow-by is plotted against engine speed for rings of different widths.

One possible result of inadequate lubrication is piston seizure, and when that occurs, the problem is often referred to the piston manufacturer. Piston design for Diesel engines was dealt with in the symposium by Fred Zollner of the Zollner Machine Works. His firm grinds piston skirts elliptically and experimentally determines the "ellipticity" required at the top end for minimum safe clearance. To ensure a uniform skirt bearing the "ellipticity" is reduced toward the lower end in accordance with the temperature drop. Ring grooves, said Mr. Zollner, must be square with the piston axis, and their faces must be given a 4-6 micro-inch finish. If the sides of the ring groove are rough, the ring, in being pressed against one side by the gas pressure, becomes practically solid with the piston and may actually leave the cylinder wall when the direction of piston side thrust changes. Piston lands must be made sufficiently wide so they will not deflect appreciably under the side pressure of the rings. Piston rings in general are made to SAE standards, except that the top ring is made narrower and deeper, to lower the radial unit pressure of the ring due to gas pressure and reduce the scuffing tendency.

Problems connected with piston design and lubrication were rendered more difficult by the adoption of

supercharging, which increases the tendency of the rings to stick in their grooves. This difficulty can be met by carefully grading the diameters of the ring lands so as to make the clearance at operating temperatures the same as on the skirt. If necessary, the lands should be cam-ground and held to close limits. If still further refinement is necessary, the ring in the top groove may be made of keystone section.

Practically all of the piston and ring lubrication troubles can be traced to excessive piston temperatures, and relief always can be had by recourse to oil cooling. There are three possible methods. The simplest consists in spraying oil directly against the under side of the piston head and the inside of the ring belt. The other methods consist in casting copper coils in the

head or casting the piston with a recess in the head which is closed by a cover plate. These latter methods, however, are apt to give trouble from coking.

When a new engine under development is turned over to the experimental department and it is put on the test block, one of the first things to be noted is whether the oil gage shows the proper pressure. During the first stages of experimental development the rate of oil consumption is ascertained, and if necessary, steps are taken to bring it within permissible limits. According to Mr. Stahl, the experimental department will determine the rate of oil consumption at the governed speed, the relative smoothness of the curve of oil consumption vs. speed, and the probable oil consumption of the

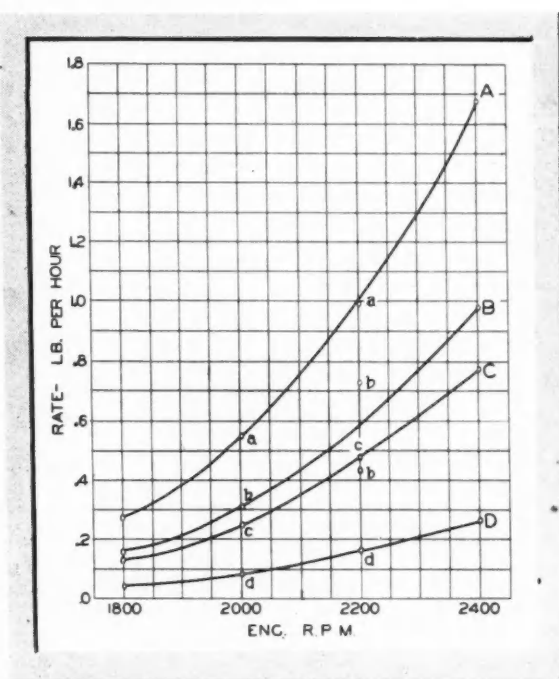


Fig. 2—Hourly oil consumption vs. engine speed with four different oil-control equipments.

truck in which the engine is to be installed, in miles per quart or per gallon. It will also give thought to the severity of the changes in the ring equipment which had to be made to get a satisfactory consumption. In order to get this information, full-scale test runs are made over the entire speed range with different ring equipments, and the oil-consumption figures are plotted against the speed. A family of oil consumption curves thus obtained is shown in Fig. 2, from which it will be seen that by changing the oil-control equipment, the consumption at any given speed can be varied within wide limits. Mr. Stahl said a consumption of 0.3 to 0.5 lb. per hour is considered normal for engines of 350 to 600 cu. in. displacement. The four curves in Fig. 2 show that with each control arrangement the proportional increase in the rate of consumption between 1800 and 2400 rpm is about the

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PRODUCTION LINES

On Conservation

In the interest of conservation of critical materials, The Carpenter Steel Co., through its field engineering service, is issuing bulletins which outline constructive ideas touching on conservation as well as on improvements in manufacturing techniques.

One important suggestion to those who use stainless steel sheet in blanking, forming, or drawing operations, is to investigate the feasibility of employing narrow strip instead. In many instances the change to strip eliminates slitting and reduces scrap loss. One important plant reported a saving of 40 per cent in material by adopting strip of the right width for the particular job.

Another valuable suggestion along the lines of conservation is to make sure that full advantage is being taken of the high tensile properties of stainless steel. Rechecking may indicate the possibility of using a lighter gage strip. Frequently, lighter gage strip may be adopted to advantage by the expedient of adding an embossed rib for stiffness.

Correct fabricating speed is as vital in press operations as it is in machine

shop practice. It is of interest to note that stainless steel strip when specified in coils will aid in speeding the function of progressive dies due to its accuracy and uniformity of gage. A quick check-up of your press speeds will indicate that, on occasion, slower speeds may result in increased output by reducing rejects and increasing the life of precious tools.

Finally, good practice demands a thorough investigation whenever rejects begin to get out of hand. In press shop operations with stainless steels, it is found that undersized strip can cause wrinkling in the die. Oversized gage may account for galling or tearing. This calls for a careful inspection of tool layouts, die clearances, and lubricants. The latter, particularly, play a vital role not only on metal cutting machines but on presses as well. It is amazing what improvements can be made with the use of drawing compounds of the right type, selected by experts, for a specific operation.

Plant Efficiency

That's the title of a valuable treatise just issued by the War Production Board. It is specifically directed to

ideas and suggestions for increasing the efficiency of smaller manufacturing plants. The booklet touches on the role of supervision, on the adaptation of old machines, on adequate machine and tool maintenance. One of the most important suggestions is contained in a chart giving information on the machinability of SAE steel grades. The bulletin also touches on the vital role of cutting fluids. Certainly that is something that all plants must bear in mind. The various cutting fluids producers will be glad to work with anyone interested. In fact the Independent Research Committee on Cutting Fluids which has been mentioned in this column on occasion will be glad to aid anyone who needs assistance. You can call on us at any time.

On Precision

One aspect of precision has to do with the technique of metal cutting and the proper functioning of precision machines such as grinders. This subject is treated objectively in May *Lubrication* issued by the Texas Company. Chief emphasis is on the role of cutting fluids in metal cutting operations and this is discussed quite comprehensively. In addition to the selection of the right cutting fluid for each type of operation, the bulletin also touches on the care and maintenance of the bearings and ways of precision grinders, indicating the types of lubricants best suited. We urge you to get a copy of this bulletin in the interest of keeping your metal cutting operations on the most economical level.

Pneumatic Cylinders

A catalog giving the details of the complete line of Hannifin pneumatic cylinders and various types of control valves is just off the press. If you want to get your files up to date, ask us for a copy of Bulletin No. 57.

On Standards

The vital role of standards in the war effort is pictured dramatically in the June, 1942 issue of *Industrial Standardization*. It contains articles on the use of standards in the OPA price control program, in conserving scarce materials, and in simplification. One article, on standards in Army procurement, outlines the new procedure in quality control based upon statistical methods which has been applied so skillfully by the Ordnance Department.

—J. G.



The twisted wreckage, an aerial gun carried by one of the Japanese bombers shot down at Pearl Harbor, is on display at the Hudson-operated U. S. Naval Ordnance Plant. George M. Beck (right), principal inspector of ordnance for the Navy, is shown pointing out features of the gun's construction to Alfred Dixon and George Frohriep, who assemble anti-aircraft guns there.

Morale-Building Activities for

MACHINES and material cannot be inspired into producing more armaments to beat the Axis.

But men and women employees are open to such persuasion and appeals to their patriotism often will bring improved production, both as to quantity and quality. The instilling of this war consciousness in their workers is a major problem that several of the automotive companies have undertaken to solve in an intelligent and well-directed manner. Extensive campaigns have been launched in the plants to provide the inspiration, information and education that must be imparted to the employees if the constantly increasing production quotas demanded by the Army and Navy are to be met.

Oldsmobile Division of General Motors Corp. was one of the first companies to undertake a morale-building program that would increase its employees' contribution to the war effort. Not long after Pearl Harbor, S. E. Skinner, general manager of Oldsmobile, conceived the campaign's keynote, "Keep 'Em Firing," in recognition of the division's production of weapons and ammunition for the armed forces. So well has the program been put across that the entire population of Lansing, Mich., is conscious of Olds' war endeavors and it even has been carried into the plants of more than 200 sub-contractors and suppliers throughout the East and

Midwest to make their employees realize that they help "Keep 'Em Firing," too.

Throughout the Oldsmobile plants are more than 500 posters, well conceived and in bright colors to attract attention, to keep the workers constantly reminded of the job to be done. Some of the posters, which are changed every three weeks, present a comic aspect of the future fate of the Axis partners, while others stress the use of the Olds-produced armaments by members of the U. S. armed forces. Production scoreboards also are located in various departments throughout the plants to provide a competitive angle to war production. At first daily departmental quotas were established on the basis of Government contract schedules.

Departments each day tried to beat the previous day's production. Now that output has reached a fairly high level, the competitive aspect has been changed by pitting each of three shifts in a department against

THROUGHOUT the industry the importance of workers' morale is recognized as a definite aid in boosting war production and companies have organized effective programs toward that end. This article, which describes the morale-building activities at the plants of three companies — Oldsmobile, Hudson and Packard, presents them as typical illustrations of the programs being promoted generally.

Workmen of the U. S. Naval Ordnance Plant operated by Hudson looking at one of the displays of Navy photographs posted throughout the shops. The pictures, showing naval ordnance in action, help to drive home to the men the part they are playing in the war effort.



War Workers

By E. L. Warner, Jr.



(Above) Stimulus to Packard workers is this graphic way of portraying the war production job just done, and projecting the increased goal ahead. Scoreboard posters like this are placed in strategic plant locations.



(Left) Thousands of Oldsmobile employees entered slogans in their recent contest. The slogan, "If you can't go across, come across, Produce", took first honors.

each other to see which can turn in the day's best output record.

A tool conservation drive recently was launched to cut down breakage of vitally needed tools and parts that are difficult to replace in the current all-out production effort by U. S. industry. An educational exhibit of broken tools and parts was set up and shown to factory supervisors. Then smaller displays were placed in various departments to acquaint the workers with the seriousness of the problem and to educate them to use more care with tools that may be impossible to replace immediately.

Employees are encouraged to make suggestions for improved operations and production methods in line with the General Motors suggestion campaign, with defense stamps and bonds as the reward for accepted ideas. More than 7500 employees contributed to a one-week war production slogan contest. Winner of the \$100 defense bond for first prize was Percy J. Powers, an Olds employe for only 14 months, whose slogan was: "If you can't go across, come across—PRODUCE." Workers with creative talents are urged to express their patriotism. One such man, Donald R. Norris, drew a very creditable poster which was exhibited in the plant. Entitled, "What's In It For Me?"

Slavery If We Fail," it depicted a bloody Hitler, sword in hand, confronting a shackled worker.

To keep employees conversant with the progress of the war and to stimulate war morale, news bulletins are posted three times a day on two bulletin boards in the plant, one adjacent to the lunchroom.

The "Keep 'Em Firing" keynote is carried outside the plant to the City of Lansing and elsewhere by the workers and by a well-conceived patriotic advertising campaign. Each worker wears a silver lapel button carrying the "Keep 'Em Firing" motif that identifies him as a war plant worker. There also are "Keep 'Em Firing" windshield stickers for workers' automobiles and similar stickers for display in the front windows of workers' homes. Merchants display "Keep 'Em Firing" posters in their show windows while billboards on main arteries leading into Lansing carry the same message. Newspapers also have carried patriotic Oldsmobile institutional advertisements on the same subject. Metered mail broadcasts the Olds' keynote to all parts of the country.

Mailed to every Olds worker at his home is the Oldsmobile "Cannoneer", a lively and readable employee publication devoted to putting pep into the division's war production. A newspaper-size eight-page monthly, the front page usually carries an inspirational war message from President Roosevelt or other high government officials telling of the performance of Olds-built weapons in action. The "Cannoneer" also carries personal items from the various departments written by employees. It is profusely illustrated with pictures of workers and plant news "shots". A recent double

Displays of broken tools and parts are shown to workers at the Oldsmobile plant to impress them with the seriousness of the situation. This photo shows a group of supervisors in the office of John Dykstra, Oldsmobile's factory manager, preliminary to launching a drive to minimize tool breakage in all departments.



page spread carried the pictures of 34 Oldsmobile fathers and their sons in the armed services, thus personally linking the workers with the Army and Navy. Another picture page featured 12 Oldsmobile husbands and wives where both members of the family were employed at Olds. The "Cannoneer" has a press run of 17,000 copies, which are mailed to employees of suppliers and sub-contractors as well as Oldsmobile workers. In addition, 350 ex-Olds workers in the armed forces are on the mailing list.

Oldsmobile also sponsors at certain seasons of the year a weekly half-hour radio program featuring a 150-voice junior choir composed of the children of Olds workers. The studio audience is filled with the families of Oldsmobile employees. Each program is marked by a patriotic message bringing in Oldsmobile's contribution to the war effort and stressing the "Keep 'Em Firing" motif.

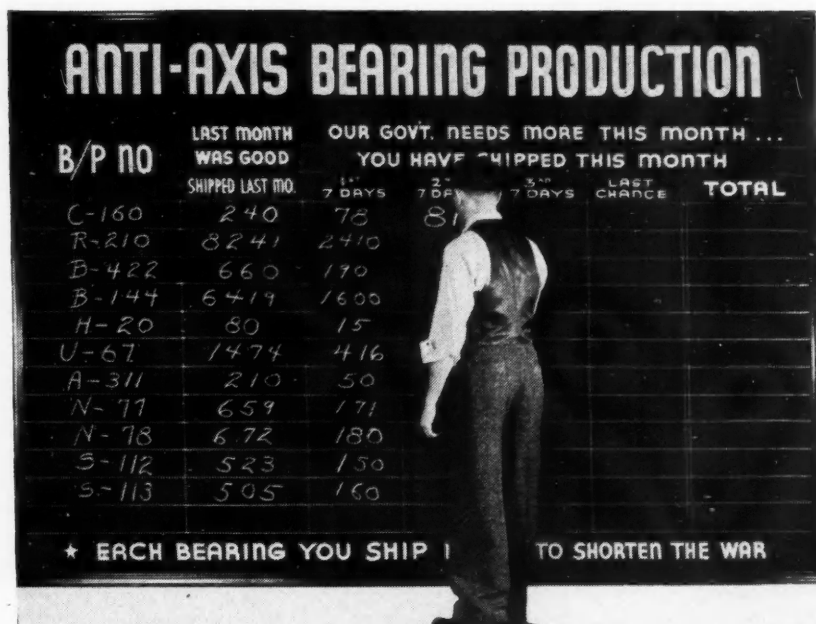
Heading the "Keep 'Em Firing" program is V. C. Havens, Oldsmobile's director of advertising and sales promotion. He is assisted by a staff of eight members, including two men who are on the road con-

stantly carrying the message to the plants of sub-contractors. More than 200 of Olds' 450 sub-contractors already have adopted the "Keep 'Em Firing" program for their employees. Oldsmobile furnishes the necessary posters, stickers, lapel buttons and a monthly mailing of the "Cannoneer" to these plants at cost.

Hudson Motor Car Co. also has been active in promoting morale and war consciousness among its workers in plants making aircraft parts and in the U. S. Naval Ordnance plant operated by Hudson. The impact of the war is brought home to Hudson workers by pictures and displays showing Hudson-produced guns in combat.

A spontaneous reaction to this program was the organization of the Hudson "Gun-of-the-Month" Club among employees at the Naval Ordnance plant. In March the employees of this plant contributed an anti-aircraft gun costing several thousand dollars as a gift to the U. S. Navy. Capt. Glenn B. Davis, assistant chief of the Navy Bureau of Ordnance, accepted the gun on behalf of the Navy at ceremonies held in the plant between shifts and attended by several thousand workers. Secretary of the Navy Frank Knox sent a letter of commendation praising the workers for their patriotic spirit.

This Hudson gift gun has now



An example of the use of blackboards to keep employees informed regarding progress being made in production of war material is this Anti-Axis Blackboard employed by the Bantam Bearing Corporation to show output per week of certain important B/P No.'s on the production schedule. Every glance at the board reminds the workers that each bearing shipped will help to shorten the war.

been installed on one of the destroyers which was damaged by Jap bombs at Pearl Harbor. Enlarged pictures showing the ship burning at Pearl Harbor, then being towed across the Pacific to a West Coast port for repairs and refitting, have been posted throughout the Hudson plant. Another picture shows the ship's commander reading the gift inscription on the gun. Each member of the Hudson "Gun-of-the-Month" Club carries a pocket-size card on which to record his monthly contributions. Around the edge of the card instead of months are printed the names of a dozen United Nations' disasters in the present war. Thus each contribution checked off on the card is symbolic of retribution.

Special displays of Navy photographs showing Hudson-produced guns in action also are shown prominently in the plant, the Navy Department personnel cooperating in arranging these displays. Dramatic motion pictures, such as a recent screening of "The Gun," a British-produced film that showed the performance of a gun similar to that Hudson is making in the bringing down of a Nazi bomber by a British



A Packard workman receives this merit badge for turning in outstanding production, making an unusual suggestion, or some other contribution to the war effort that singles him out.

what their contribution was to "Keep 'Em Flying."

Hudson also maintains departmental scoreboards on which employes can compare actual production totals with the quotas set by the War or Navy Dept. An employe publication, the "Salvo," is mailed to workers at the Naval Ordnance plant every two weeks. Director of Hudson's morale-building activities is R. G. Waldron, personnel manager.

The reply of Packard Motor Car Co. to Donald M. Nelson's appeal for a production drive in war industry was the "Work to Win" program, an elaborate campaign to boost output and instill the war spirit in more than 20,000 Packard workers who are engaged in making aircraft and marine engines for the government. This program has the hearty endorsement of Curt Murdock, president of Packard Local 190 of the UAW-CIO, who pledged the union's 100 per cent support. A six-man management-labor committee is directing Packard's "Work to Win" drive. Management members are B. C. Budd, former Packard export manager, who is chairman; David Livesey and C. E. Weiss, personnel managers. The program has the full backing of George T. Christopher, Packard president, who was one of its sponsors.

Packard launched its drive with a dinner at the plant for more than 700 chief stewards, foremen and departmental heads. Among those addressing the meeting were officials of the Army, Navy, War Production Board, the union and the company. A slide film showed them the chief points of the "Work to Win" program. A colorful "Work to Win" bulletin, illustrated in red, white and blue, then was mailed to employes at their homes. This bulletin contained a pledge card which the employe could sign and return to his foreman in exchange for a celluloid red, white and blue "Work to Win" button.

Later the employes receive war worker pins, those in the marine division marked by an anchor and those in the aircraft division with half of an aviator's wings. As a reward for outstanding accomplishment, em-

(Turn to page 82, please)



One of several production scoreboards in the Packard "Work to Win" shop program is this miniature battlefield. "Armies" of tiny soldiers representing plant divisions move forward according to the weekly output of each group. Objective is to be first to reach the monthly production goal.

convoy, are helpful in stimulating employe morale.

Families of Hudson employes participated in a recent celebration that marked the shipment of the first bomber fuselage section by the company. Speakers at the program included A. E. Barit, president of Hudson; J. T. Hartson, executive vice president of the Glenn L. Martin Co., for which Hudson is making sub-assemblies; Victor G. Reuther, assistant defense co-ordinator for the UAW-CIO, and Capt. Walter R. Godard, of the Army Air Corps. Refreshments followed the speeches and then the workers and their wives and children visited the airframe assembly division, permitting the men to show their families just

Germany's New Dornier 2

This is the second part of an article, which is devoted to the controls, armament armor, bomb installation, electrical and radio equipment, and instruments, of the E-1 model of the new Dornier 217 bomber. The first part was presented in the July 15 issue of AUTOMOTIVE and AVIATION INDUSTRIES.

PART TWO—Controls

On the control panel the throttles are connected by rods and levers. Each quadrant on this control panel has a red plate at the forward end marked (in German) "Max. take-off power, 3 min.," while a hinged plate at the rear has to be lifted to allow full rearward movement, which stops the engine.

The usual fuel cock controls for the engine pump suction lines are fitted. Three levers to the rear of these are a fuel tank selection lever (probably on the transfer system), a lever controlling air pressure supply for "additional" tanks (with a warning that jettisonable wing tanks are to be emptied before the fuselage tank) and a jettisoning lever for "outer" tanks.

On the roof above the instrument panel are two spring-loaded manually-operated propeller pitch change control switches with checks for feathering position at the coarse pitch end. In front of the throttle lever are two switches bringing into effect a hydraulic constant speed control mounted on the engine nose. On the starboard side gage panel are switches for fuel transfer pumps and for tank pumps to supply the engines. On the instrument panel are two two-way switches for cylinder cooling control and two spring-loaded switches for varying the oil cooler air flow.

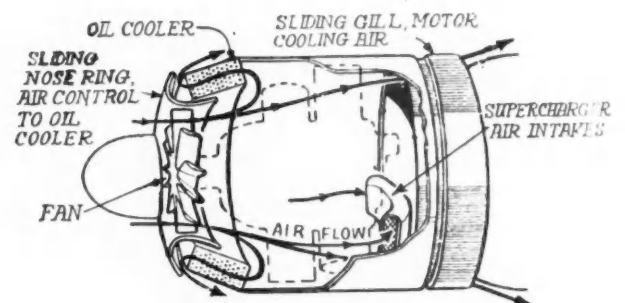
Fuel contents gages have scales reading to: Main port tank, 785 liters; main starboard tank, 785 liters;

auxiliary tank (middle) 1100 liters. A red light indicates when the fuel content in the middle tank drops to that allowing "20 min. flying time."

Armament

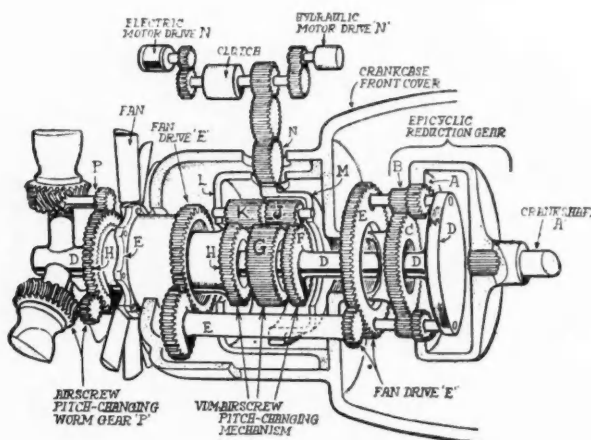
One fixed M.G.151 (15 mm) gun is mounted in the lower port side of the nose, firing forward and operated by the pilot using a Revi 120 gunsight. Approximately 250 rounds of ammunition are carried in a box on the port side of the nose, with a rigid chute.

Three M.G.15 (7.92 mm) guns are fitted, two firing laterally through the rear upper side windows and operated by the W/T operator, and one in a central position. All three are on gymbal mountings. Twenty-eight spectacle drums of ammunition (75 rounds each) were carried. The cockpit cover was missing and this presumably had either one or two M.G.15 guns, firing aft and also operated by the W/T operator. Two further gun positions, with gymbal mountings to take M.G.15 guns are located on each side of the cockpit,



ENGINE DETAILS—(Above) The nacelle arrangement of the cooling and cooling and (left) the gearing of the airscrew and fan drives. The controllable pitch gear for the V.D.M. airscrew is incorporated with the engine reduction gear instead of behind it as formerly.

The airscrew and fan drives are shown diagrammatically at left as follows:—



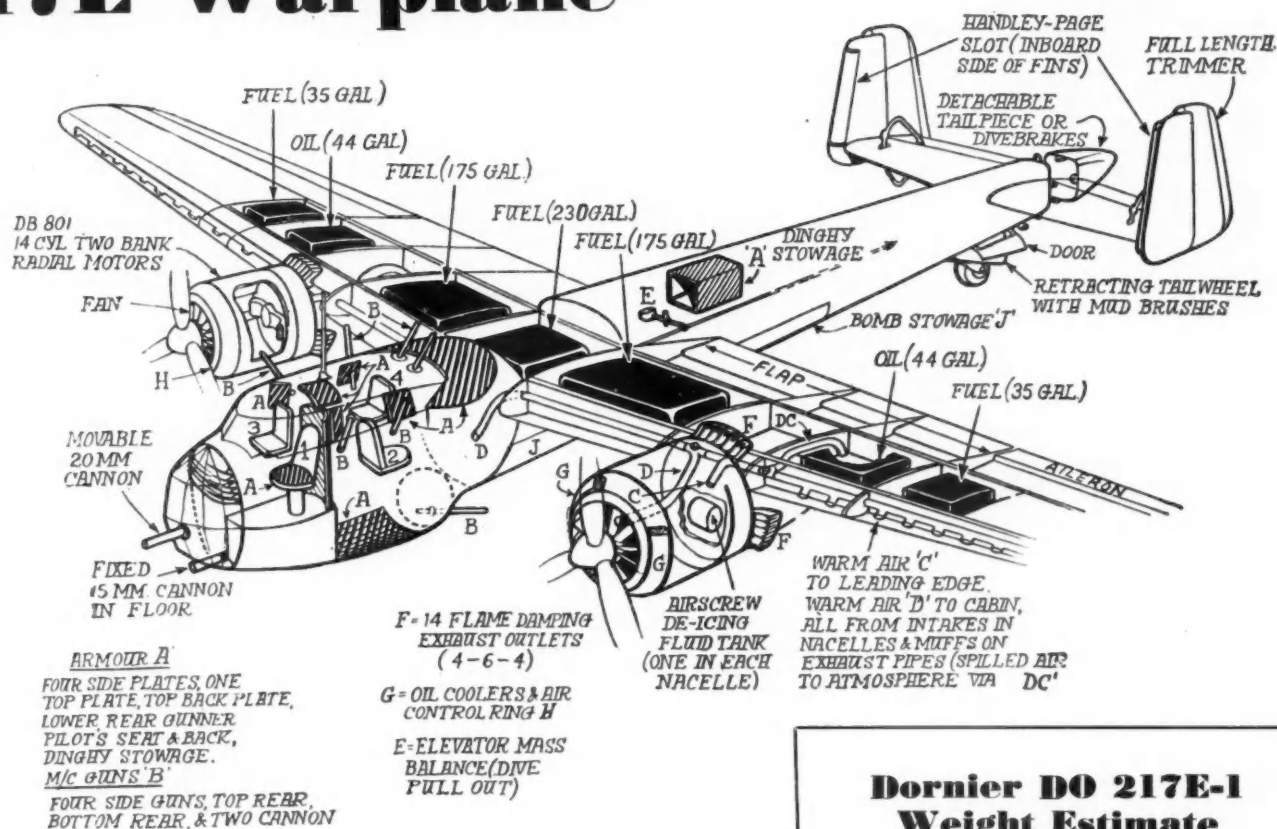
A drives B-B rolls around C which is fixed to crankcase and drives airscrew shaft D-C also drives E which carries fan.

Airscrew Change Pitch Gear—F fixed to D drives freewheel G through J (J carries rotatable drum M which can be rotated by N). G drives H through pinion K on stationary bracket L fixed to crankcase. H drives pitch change worm gear P. H and F have the same number of teeth. G has fewer teeth but same diameter as H and F.

by M. W. Bourdon

Special Correspondent of
AUTOMOTIVE and AVIATION
INDUSTRIES in Great Britain

217E Warplane



DORNIER LAY-OUT—A diagrammatic view which illustrates the chief features of the Do 217E-1. Fuel and oil tank capacities are given in Imperial gallons.

Dornier DO 217E-1 Weight Estimate

Wings and center sec.....	4600 lb
Fuselage	2950
Controls	600
Tail unit	610
Undercarriage	1830
Power unit	6150
Engine mountings	900
Armor	400
Fixed equipment	900
Empty weight (tare).....	18,940 lb
Movable equipment	610
Crew (four)	800
Fuel (650 Imp. gal.).....	4835
Oil (83 Imp. gal.)	800
Ammunition, etc.	1100
Bombs (max.)	6615
Max. loaded weight	33,700 lb

but no guns were fitted here. A mounting for a free 20-mm cannon was noted in the lower starboard side of the nose, for use by the bomb aimer, but here again no gun was fitted and the gun port was blanked off by a sheet of metal.

The 15 mm ammunition found was of two types only, one with a yellow body and brass nose fuse (probably H.E./tracer) and the other with a black body of the sharply pointed A.P. type. They were in cycles of two yellow and one black.

Armor Protection

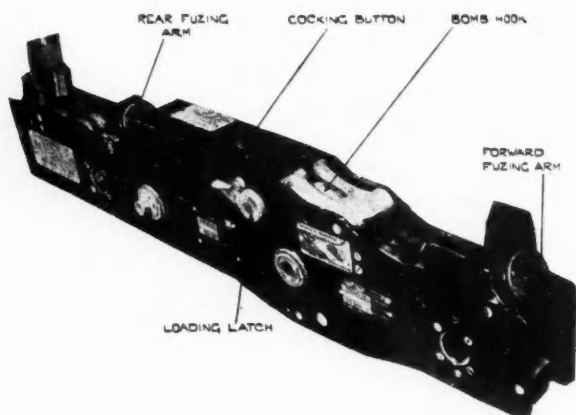
The armor protection of the pilot's seat consists of a curved shield 8.5 mm thick around the back. The bucket of the seat also has armor plate about 5 mm thick; plate of the latter thickness is also provided on top of the cockpit, above and slightly to the rear of the pilot's head. Two curved triangular plates, 5 mm thick, are on each side of the rear upper cockpit, probably an extension of the armor which would almost certainly be fitted to the rear of the missing cover of the cockpit. A large curved plate is also fitted on top of the fuselage immediately aft of the cockpit. A bulkhead, 8.5 mm thick, roughly semi-circular in shape was found in the wreckage; it may have

been located aft of the central gunner who is otherwise unprotected from the rear. The stowage recess for the inflatable dinghy is armored with 8.5 mm plate at the rear and 5 mm plate along the sides, bottom and top.

Armor Plate Analysis

Three samples of the armor plate from this machine were examined as follows:

1. Pilot's seat back. A welded component, 8.5 mm thick. 48 by 21 in. weighing 126 lb.
2. Curved plate from upper part of fuselage, 5.5 mm thick. 26 by 15 in. weighing 15 lb.
3. Transverse bulkhead, 8.5 mm thick, 44 by 20½ in. weighing 58 lb.



Bomb carrier-release and fuzing unit.

The composition of these components differed from that of other samples of German armor plate previously examined. It was determined by chemical analysis and found to be:

	No. 1	No. 2	No. 3
Carbon	0.49	0.30	0.48
Silicon	0.96	1.33	0.97
Manganese	0.73	0.71	0.73
Nickel	Trace	1.13	Trace
Chromium	1.49	1.08	1.48
Molybdenum	0.23	Trace	0.21
Vanadium	Trace	Trace	Trace

The diamond pyramid hardness number of the core of each sample was determined and the approximate tensile strength, as follows:

Sample	D.P. Hardness No. ($H_D/50$)	Approx. Tensile Strength
No. 1	434	95 tons/in ²
2	559	110-120 tons/in ²
3	432	95 tons/in ²

Microsections were prepared from the edges of the samples. The microstructure of each was martensitic. Scale was present on each sample, and decar-

burization had occurred at the two major surfaces of each plate to a depth of about 0.0020-0.0025 in. Some decarburization was present also at the surfaces of countersunk holes in samples 2 and 3, showing that these had been drilled before final heat treatment.

With regard to samples 1 and 3, a similar type of steel was used for armor plate in a Messerschmitt 109 aircraft, but this contained less silicon, more chromium and more molybdenum, and was somewhat harder (diamond pyramid equivalent-457 to 484).

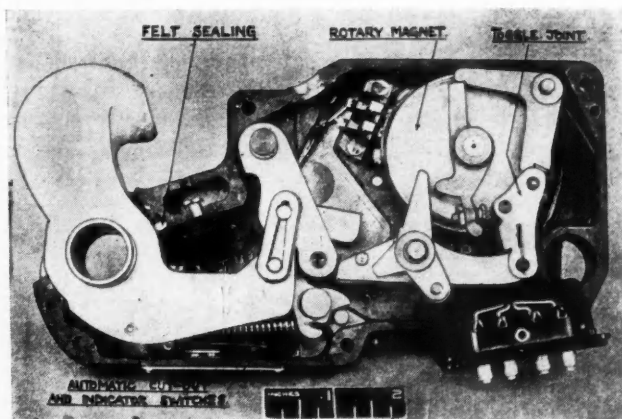
Bomb Installation

The bomb installation is entirely different from that of the Do 17Z. The carriers also are new. On the Do 17Z the bomb cell occupied the whole depth of the center section of the fuselage, having stowage for either 20 by 50 kg bombs stowed in tiers of five, or two 250 kg bombs along the center line of the aircraft. But on the machine under review the top half of the center section of the fuselage is fitted with a fuel tank and inflatable boat stowage, and only the lower half is used as a bomb cell, fitted with four 500 kg carriers, two on each side.

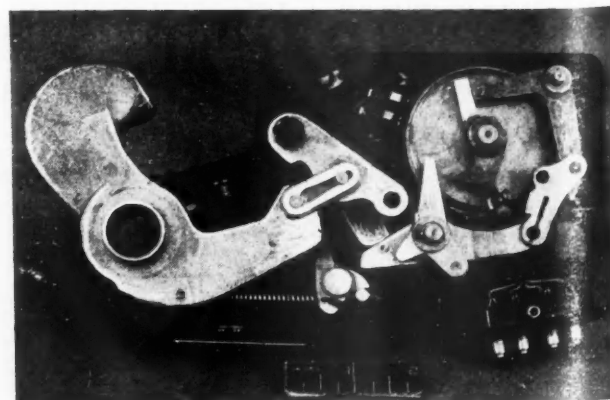
A pair of channel girders, back to back and about 3 in. apart, comprise the bomb beam in which the E.M. release and fuzing unit is held and to the outside of which crutch arms are fixed, the crutch feet being adjustable in pairs by means of a lever on the side of the beam. One continuous section of this beam is fixed permanently to the aircraft structure along each side of the top of the bomb cell, each section being fitted to take two bombs.

The release unit and two fuzing units for each carrier are held between two stout steel plates, 60 cm by 13 cm. They form a single unit intended to be fitted to the bomb and hoisted with it to the beam. The unit is held in the beam by two 2.25 cm bolts, which are engaged or withdrawn by a rack and wheel gear operated by a lever on the side of the beam.

The release mechanism works on the toggle-lock principle and is operated electro-magnetically by means of a standard Siemens rotary magnet. It also incorporates mechanical release mechanism, a loading latch, cocking button and a small window to check visually that the unit is cocked. The Rheinmetall fusing units,

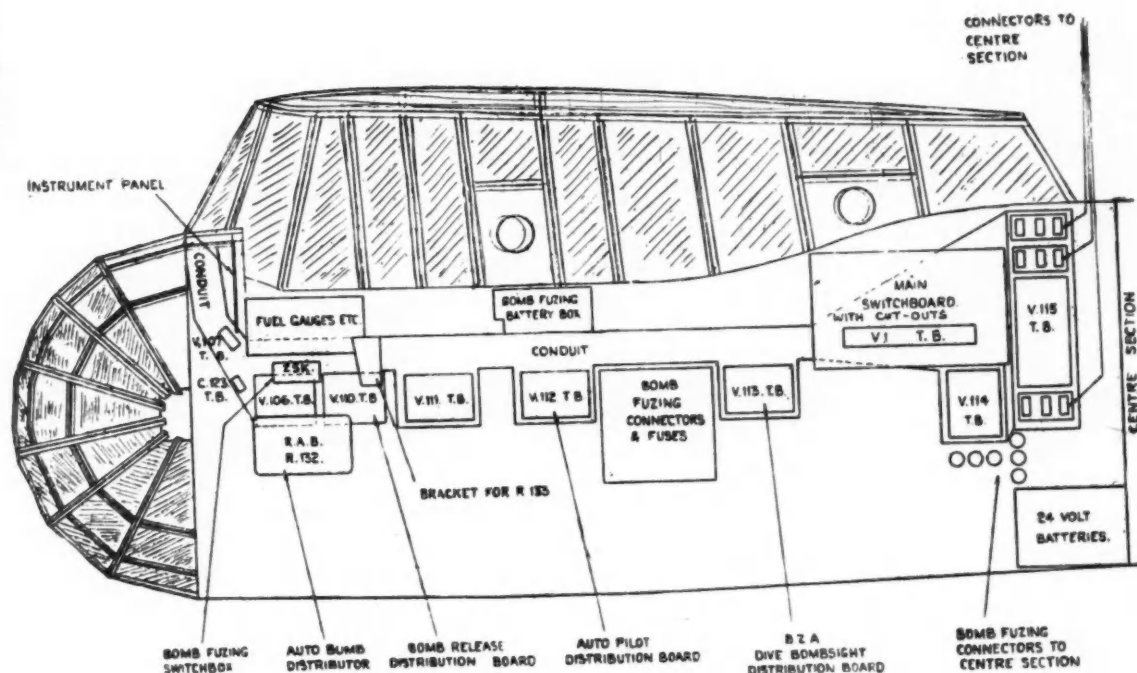


Bomb release slip in cocked position.



Bomb release slip in released position.

Starboard side of cabin, showing layout of the electrical conduit and the distribution and terminal boards.



two on each carrier, are of the swivel type, instead of the more usual telescopic type.

Strong points in the roof of the bomb cell indicate that alternative bomb stowages are possible, probably either four P.V.C. 1006 carriers to take mines or larger bombs, or one torpedo carrier along the center line of the fuselage.

Holes for attaching a large bomb carrier and electrical connections for release and fusing are provided under each wing, outboard of the engine, 18 ft. 6 in. from the center line of the fuselage. There is also provision to enable extra fuel tanks to be carried under the wings as an alternative to bombs. In the cockpit are the usual bombing controls, i.e., R.A.B. bomb distributor, fusing switch box, bombsight, emergency mechanical release lever and the "live-safe" lever for use with mines.

Electrical Installation

The electrical system is extremely complex. Except for the bomb fusing system, all services are operated from the 24-volt supply. On the main switchboard, and apparently connected in the generator circuits, is a flow-discharge tube of a new type. The circuit breaker switches are also of a new design; about 70 are used throughout the aircraft. Two 12-volt 45 amp-hr batteries are used in series.

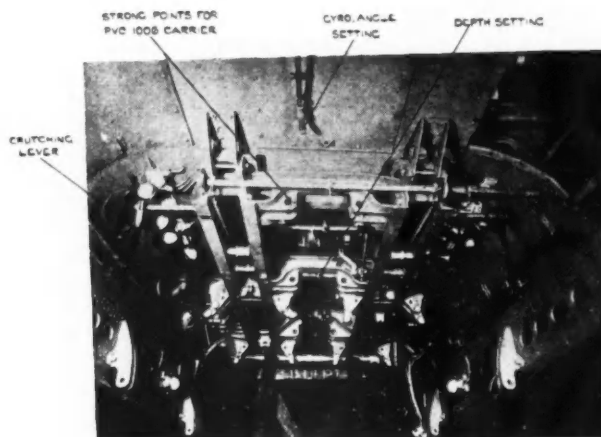
The Bosch magnetos are type ZM14, CR 10. The spark plugs appear to be Siemens. A new type of signalling lamp was found on board and a new landing lamp retractable into the port wing lower surface.

The propellers are operated partly electrically and partly hydraulically. The de-icing equipment on the blades is electrically controlled. Undercarriage, flaps, cooling gills and fuel pumps are motor operated. The pilot's seat is raised and lowered electrically.

Bomb carriers in the fuselage and those for which provision is made under the wings are all controlled

by one auto bomb distributor. The bomb doors are opened electrically and close automatically as soon as the bombs have been released.

There is provision for a dive bomb sight. A con-



Rear part of bomb cell.

tacting altimeter is fitted and electrically-controlled automatic pull-out-of-dive mechanism. The electrically controlled dive brakes, which are housed in a long projection behind the tail of the dive bomber version, were not fitted on the machine examined, but their wiring appears to be complete.

Radio Equipment

The radio equipment mounted on the left side of the fuselage has several new features, including a new blind approach course receiver covering a wave band of 30.0 Mc/s—33.5 Mc/s and having seven valves with

facilities for vernier tuning through a drum drive. The aerial used is a piece of wire about 48 in. long, attached to the aerial mast at one end and to the aerial matching unit at the other, and inclined about 45 deg. to the fuselage. The aerial matching unit differs from previous models in that the aerial input socket for the D.F. sense aerial has been blanked off and the trimmer for aerial matching has been extended to enable it to be readjusted whenever the frequency of the equipment was changed. This could be done by rotating the trimming handle until this maximum aerial current appeared on the meter provided.

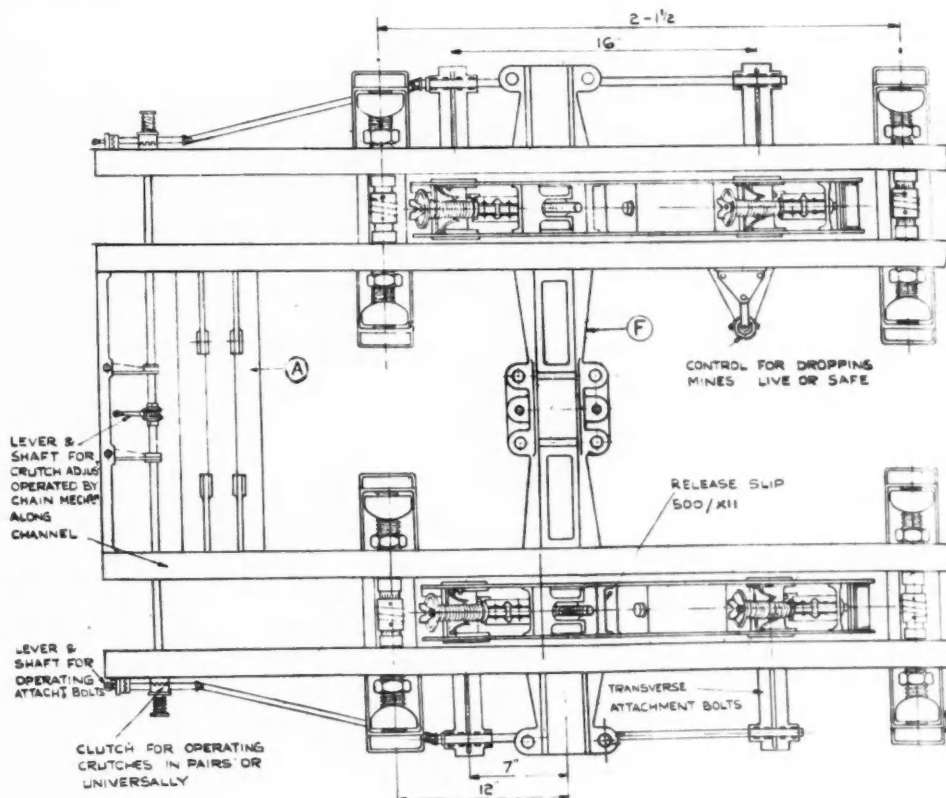
Instruments

In addition to engine instruments already mentioned, the following are mounted on the panel: Air temperature thermometer, automatic pilot indicator, blind approach visual indicator (new type), airspeed indicator interconnected with automatic pilot, altimeter, normal air speed indicator, pilot head heating indicator, course meter, bank and turn indicator, artificial horizon (new type), rate of climb indicator, directional gyro, course steering indicator and repeater compass.

The automatic pilot is of a new type controlling on three axes and made by Askania. A turn control switch giving two rates of turn in each direction is fitted on the control column. The master compass is in the rear of the fuselage about 4 ft. behind the trailing edge and above the bomb compartment.

There are no indications that the machine has been fitted to take an anti-balloon guard of the kind fitted on the Heinkel

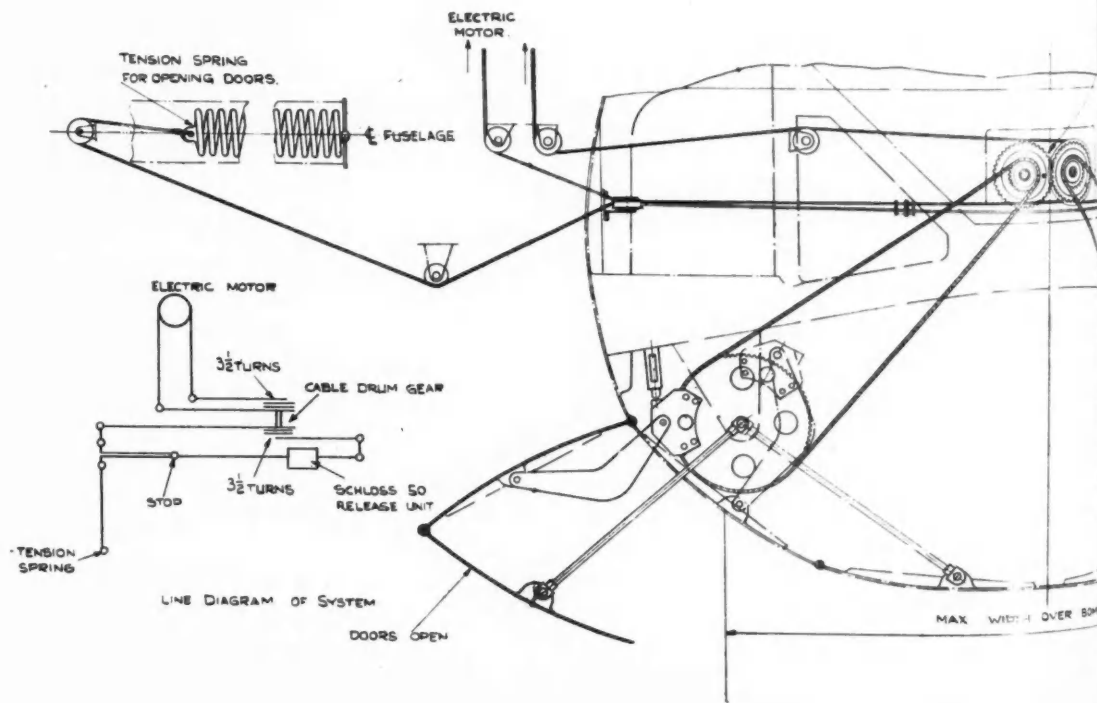
Section through front bomb cell. This diagrammatic layout shows the mechanism for opening and closing bomb doors.



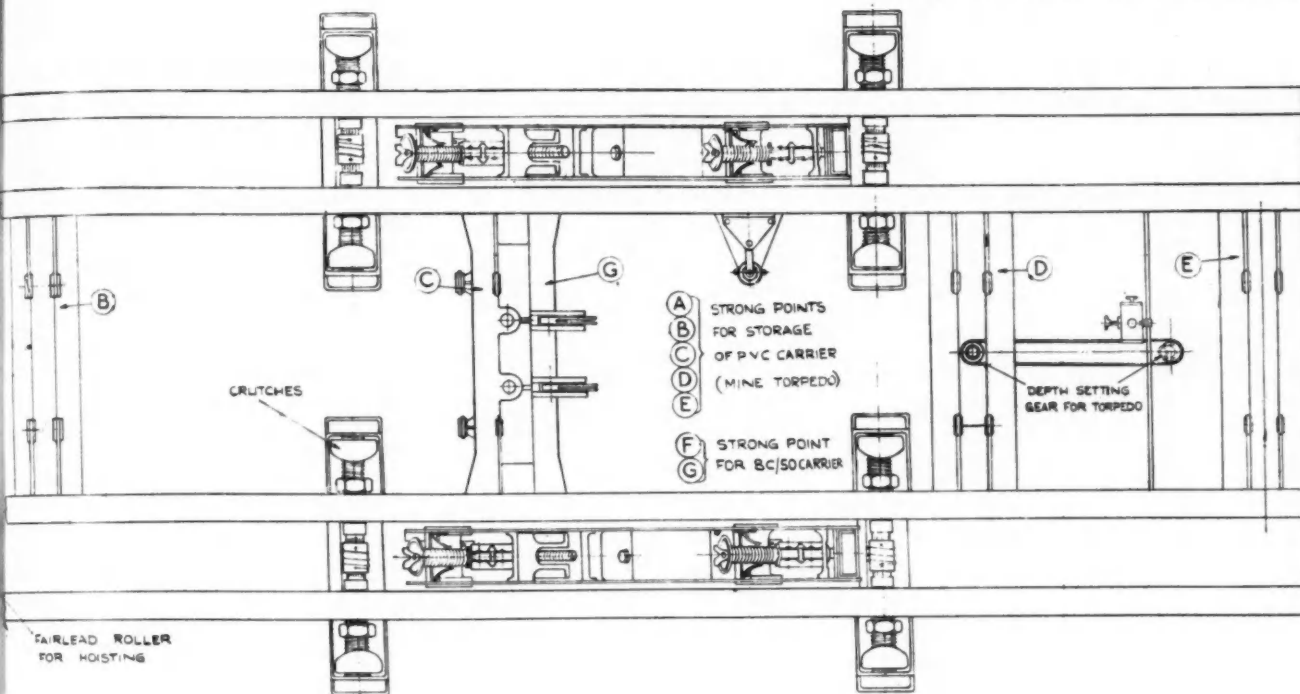
He 111. A double-barreled Vercy pistol is carried and two 3 kg charges (Gefalte Ladung) for destruction of the aircraft.

Miscellaneous

Engine auxiliaries are at the rear of the engine and are direct driven. They include a 2 kw. generator, Askania vacuum pump and a Maihak fuel pump on

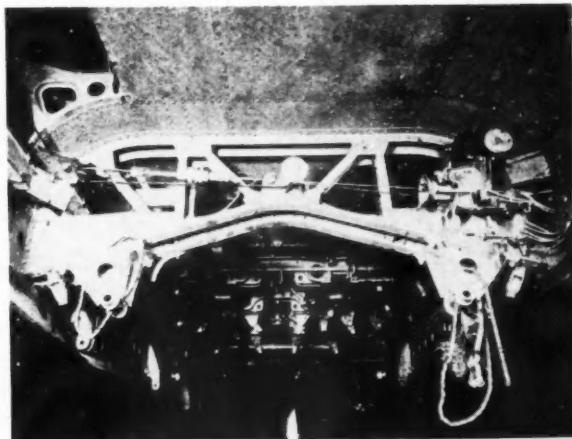


Diagrammatic layout of carriers and crutches for torpedo, mines and bombs.



each engine. The starting system consists of an electrically or manually energized inertia starter on each engine rear cover. No fuel priming system is fitted. For external oil supply, four blanked 1¼-in. bore connections are marked respectively "To cooler," "from cooler," "To engine," and "To tank," and are accessible through a cowling panel at the bottom of the nacelle.

Two red-painted bottles with green bands labelled "CO₂ for wing tanks" are fitted in the fuselage in front of the life boat compartment for fire prevention. Above the pilot's head are two cable-operated knobs



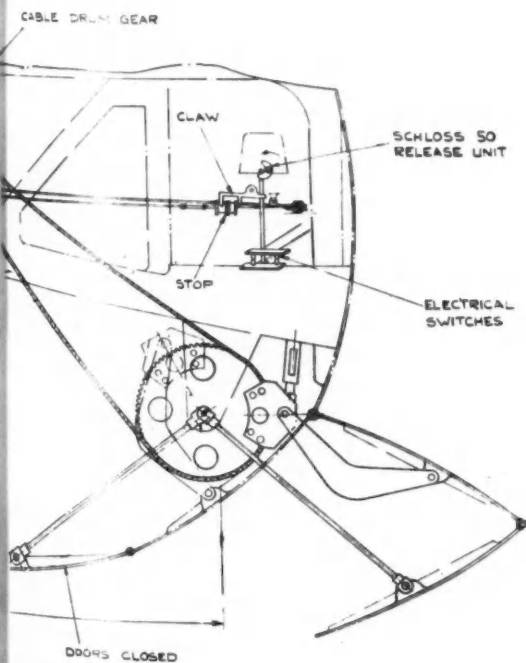
Mechanism for operating bomb doors.

for emergency release of CO₂ to left and right wing tanks and fuselage tanks. No nacelle fire equipment is provided.

An oil tank is fitted outboard of each engine nacelle, in the wing. The dipstick gave 250 liters capacity, but the wing cover plate is marked "For only 200 liters."

Wearing Surfaces for Aluminum-Bronze Sleeve Valves

ONE advantage of sleeve valves is that they permit of the use of light-alloy (aluminum or magnesium) cylinders without liners. H. R. Ricardo and J. F. Alcock in a British patent, recently issued, suggest the use of aluminum bronze for the sleeve. They state that to insure proper bearing conditions, one of the two rubbing surfaces in contact must be hardened.



Alternative

Motor Fuels—

THE war now has become a world conflict, and conservation of liquid fuel supplies, therefore, becomes increasingly important. Increased and intense activity by the United Nations on land, sea and in the air will result in a steadily increasing demand for petroleum products from the forces, and the supplies now available for the ordinary user may be further curtailed.*

From the beginning of the war gasoline has been rationed by the British government to private car owners and transport concerns, and this has resulted in a search for alternative fuels.

A number of such fuels are now in use in Britain, and while they are only palliatives, they, nevertheless, are of real value to the fuel user. The alternative fuels employed in Britain may be divided into the following categories:

1. Producer gas generated in producers mounted on a vehicle or trailer, from either mineral or vegetable fuels.

2. Gas compressed in cylinders.

- (a) Coal or town gas.

- (b) Sewage gas.

3. Coal or town gas carried at town-mains pressure in a fabric bag.

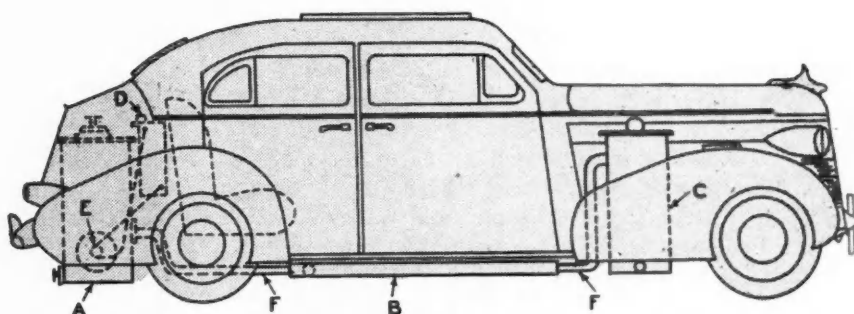
4. Creosote oil produced from coal tar.

Gas Producers

This method of operating transport consists in fitting a small gas-producing plant to a vehicle. This plant is a complete unit, is fabricated from steel by welding, and requires no auxiliary equipment. The plant comprises a gas generator which may work according to various systems, one or more gas coolers, one or more gas cleaners and filters, and various accessories such as piping for connecting the units, engine induction connections, and the usual controls.

Several types of gas producer are used, working on what are called the up-draft, cross-draft, down-draft and double or dual-draft principles. The determining factor in so far as classification is concerned, is the course taken by air drawn into the generator for gas making. In the up-draft type air passes upwards through a grate and a fuel bed, and is taken off at the

top of the chamber in the form of producer gas. This type follows the lines of a well-known stationary type of gas producer, but is a very compact unit capable of high rates of gasification. The cross-draft type uses the blacksmith's tuyere principle, air being drawn at high speed through a narrow tube directly into the fuel bed, and the gas taken off on the opposite side of the producer by a pipe which may be above, below or directly opposite to the air-inlet tube. In the down-draft gas producer air flows downward through the fuel bed, and the gas is taken off from the bottom of



A, gas generator; B, dry cleaner; C, fluid scrubber; D, water tank; E, tuyere; F, piping

Portable gas plant on passenger car

the producer, below the grate which supports the fuel.

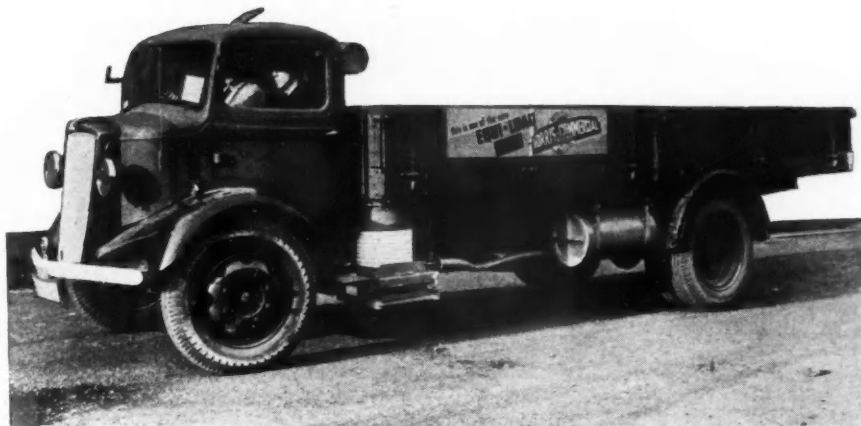
In general, the down-draft type of plant is used with tarry fuels, the tar being broken down on its passage through the hot bed of fuel. The cross-draft type is mainly used with mineral fuels, such as anthracite and coke made by carbonization at low temperatures. The cross-draft generator generally works at a higher temperature than other types, i. e., at 3600 deg. Fahr. It forms more clinker from mineral fuels, but gives better acceleration and quicker starting up than other systems. The up-draft unit is easy to work, gives a cooler and slightly better gas, and lower consumption figures. It is largely used with charcoal and low-temperature cokes, and if fitted with a cross-draft device for quick starting, it makes a very useful unit for motor vehicles.

Certain of these gas producers work with either steam or direct water injection, but, cross-draft types as a rule, do not use it.

In order to reduce the volume of the gas, cooling is essential, and is effected by running the unit connecting pipes around the chassis, and by employing a large expansion box with air tubes running through it.

* Since the above was written a decree has been issued in England which will terminate the sale of gasoline for purposes other than those essential to the war effort on June 30 next.—Editor.

Substitutes help out Gasoline Rations in Great Britain



Double-draft gas-producer plant on 6-ton truck

Gas cleaning and filtering also are essential, and the equipment which effects this is divided into dry and wet types. A dry-type cleaner consists of a cylinder or box fitted with baffle plates, and/or with filter packs of wire wool or sisal. The wet types have oiled coke, porcelain rings or wire-wool filters, and are so designed that the gas also must flow over the surface of oil and water in separate units, or through water and then through oil, before it passes to the engine. Another type of filter comprises a cylinder in the lower half of which broken coke is used as a filter, and which in the upper half is fitted with a frame covered with a number of woven fabric membranes, through which the gas must pass on its way to the engine. This type of filter, however, is not satisfactory for use with fuel containing appreciable moisture, because clogging occurs.

The connection to the engine is effected by fitting a special adapter, to which the gasoline carburetor also can be fitted. Air for combustion enters the system immediately before the gas throttle, which is fitted to the induction adapter. The air inlet usually is controlled by the driver by means of a cable.

The following particulars of a test of a gas-operated truck are of interest:

Truck—Three-quarter tonner; total weight, 14,660 lb.; payload, 7390 lb.

Engine—Six-cylinder of 3.35-in. bore and 4.73-in. stroke; 16hp. on gasoline, 80 max. at 3100 r.p.m.; compression ratio, 7.4 to 1.

Gas Plant—Up-draft with

cross-draft starting device and steam injection.

Fuel—Coke to standard fuel specification.

Fuel Mileage—0.9 per lb. of fuel.

Mileage on one Charge—89.

Water Used—One U. S. gal. per 37 miles.

Producer-gas plants are available for private cars of 10 hp. tax rating and up, and for motor trucks of up to 20 tons capacity.

Instead of fitting the plant directly onto the car or truck, units also may be mounted to two-wheel trailers.

By Norman Clarke Jones†

•These are very useful in certain classes of work, and a number of passenger buses in country services are now operated by gas plants carried on trailers.

There are a number of disadvantages connected with the use of producer gas as compared with gasoline, including increased capital cost, increased maintenance expense, reduction in power, and a consequent reduction in payload. Various expedients have been resorted to in order to increase the power, including the fitting of special pistons and cylinder heads to increase the compression ratio, advancing the ignition by about

† Associate, Manchester College of Technology, and member of Institute of Fuel, England.



Passenger car with gas producer installed in luggage compartment



Motor bus with gas producer on two-wheeled trailer

Compressed Town Gas in Cylinders

This method of using gas had not made much progress, because compressing plant and cylinders are not readily obtainable under war conditions. The equipment consists of:

1. A battery of from three to seven storage cylinders, the number and size depending upon the maximum power output of the engine, and the range required from a single charge of gas.
2. Two pressure reducing valves. These are designed to reduce the pressure from the storage vessel in two stages, first to about 8 lb. per sq. in., and then to slightly under atmospheric pressure at the engine intake, in order to prevent flow of gas when the engine is not running.
3. Suitable control valves to enable the cylinders to be charged from bottles or a compressor at a charging station.
4. An air-gas mixing device to provide a suitable air-gas mixture at the engine intake.
5. Fitting and connecting pipes for the cylinders, and a gage on the dash to indicate the pressure in the cylinders.

The cylinders are rigidly fitted to the chassis frame, and are arranged in parallel, the interconnections being made by seamless-drawn steel tube.

The cylinders are constructed of nickel-chromium-molybdenum steel, and measure 5 ft. 10 in. in overall length; they are of 8 in. internal diameter and 0.22 in. in wall thickness, and they weigh 124 lb. when

10 deg., the removal of inlet-manifold heaters, and the use of superchargers. A gasoline engine when operated on producer gas will show a loss in power of up to 40 per cent, if no modifications are made in it, but this power loss can be reduced to 15-20 per cent by using some of the expedients referred to above. In Britain it is found that the gas-driven truck gives sufficient power for most work, and it is, of course, always possible to get increased power on steep hills by feeding a little gasoline.

A gas plant can be started up from cold within one to two minutes, and the usual procedure is to start the engine on gasoline and switch over to gas. A complete plant for a 4-ton truck weighs about 450 lb., and the units are spread over the chassis with due attention to weight distribution, as well as from the gas-cooling point of view.

The fuels used in portable gas plants in Britain are mainly anthracite and "low-temperature" coke. Britain is not a timber country, so wood and charcoal are not employed, except in the case of estates where charcoal is made from waste timber. Charcoal costs about \$45 per ton, which is twice the price of the mineral fuels. When producer gas is used, 12 lb. of solid fuel go about as far as 1 gal. of gasoline.

Fuel is now marketed to a standard specification, and the user, therefore, can expect regular performance. These specifications for mineral fuel for vehicle-type gas producers cover the agglutinating power, swelling number, reactivity, ash content on the dry basis, total moisture, tar yield, and screen analysis. Provided the necessary attention is given to maintenance and cleaning of the plant, and care is taken to see that the fuel is of the proper kind, portable gas producers constitute a practical solution of the motor-fuel problem.

Fordson haulage tractor equipped with a British-Keola gas plant



empty. The capacity of a cylinder is 330 cu. ft. at a working pressure of 3000 lb. per sq. in., which is equivalent to 1.30 gal. of gasoline. The type of cylinder used will rupture without fragmentation, and for safety, they are tested annually at 4500 lb. per sq. in.

Only 10 to 15 sec. are needed at a filling station for connecting up, and a battery of seven cylinders can be recharged in 4 min. 15 sec. The cost of compressing gas works out at about 24 cents per 1000 cu. ft. of free gas, compressed and delivered into storage at 5000 lb. per sq. in.

Conversion of a vehicle to the compressed-town-gas system costs around \$410. Disadvantages associated with the system are the weight of the equipment and the limited range of operation, which rarely exceeds 50 miles per charge. The effect on engine power also must be considered, and this aspect of the matter will be dealt with in connection with the use of town gas in fabric bags.

Coal or Town Gas in Bags

This system, although rather cumbersome and inconvenient, is probably the easiest and cheapest way of changing to an alternative motor fuel. Conversions of this type involve the minimum alterations, permit the running of the engine on gas or gasoline, as desired, and cost relatively little. Simple conversions are very successful, and while optimum results are not achieved, the system affords the motorist means of increasing the use he can make of his car.

The Walsh container and equipment is probably the best apparatus of the gas-bag or low-pressure-gas type. The equipment consists of a "streamlined" frame which houses the bag. The action of the frame is governed by a system of links on the sides, together with guide cords, and the framework expands and contracts as the bag is being filled and emptied. The bags are made of a high-quality double-texture fabric with a layer of rubber sandwiched between. It has been found that about 250 cu. ft. of gas at 500 B.t.u. per cu. ft. is equivalent to 1 gal. of gasoline. This quantity of gas normally is carried in a bag 10 ft. long, 5 ft. wide and 5 ft. high, and it will be seen that the cruising range is limited. The usual practice is to fit a bag containing sufficient gas for a range of 20 miles.

The bags are filled with town gas at mains pressure through a 2-in. pipe provided with a non-return valve. Stand pipes are provided at convenient places, and no special apparatus is needed. It is the practice not to exceed 2 in. of water pressure (0.072 lb. per sq. in.) in a gas bag.

The gas is supplied to the engine by a pipe from the back of the bag. This supply pipe may be made of copper, light steel tubing, or rubber, but if the latter is used it should be of the armored type, to prevent kinking. The size of the pipe depends upon the engine power, but in no case should it be less than 1¼ in. right up to the carburetor. It is usual to fit a standard gas valve in the supply line, preferably near the engine, so that the gas can be completely closed off if desired. The supply line, in turn, is connected to the gas carburetor, of which several efficient types are on the market. The minimum requirements of a gas carburetor are:

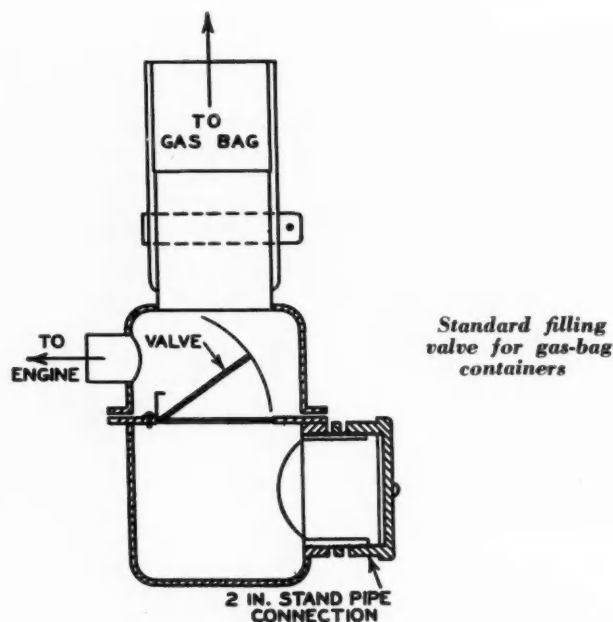
1. To cut off the gas when the vehicle is stationary.



Laundry van fitted with low-pressure gas bag

2. To give a constant mixture ratio through the full range of operation.
3. To give easy starting, freedom from stalling, and steady idling, with ready and immediate response to throttle variations.
4. To offer low resistance to gas flow, so that the maximum volume of explosive mixture can be drawn into the engine.

Several gas carburetors are now available in Britain, which are complete with gas throttle, are capable of adjustment to a wide range of mixture ratios, and can be fitted to engines of widely different design and horsepower. The most satisfactory method of fitting a gas carburetor is to provide a tee in the air intake of the gasoline carburetor. Alternative methods involve the use of a special casting which is inserted between the existing carburetor and the intake manifold, or drilling the manifold and fitting the gas carburetor to it. It is usual to connect the accelerator pedal to the gas throttle, but in some instances gas control is by hand through a cable from a lever fitted to the steering column.



Starting up on town gas is easy, but acceleration is not as good as with gasoline. For instance, a light van with a 35-hp. engine was accelerated on gasoline from a standstill to 25 m.p.h. in 9.2 sec., but it required 11.6 sec. when town gas was used.

A typical town gas in Britain has the following composition: CO_2 , 2.3 per cent; O_2 , 0.6 per cent; C_3H_8 , 2.6 per cent; CO , 10.8 per cent; CH_4 , 21.1 per cent; C_2H_6 , 0.7 per cent; H_2 , 54.4 per cent; N_2 , 7.2 per cent. The gross heat value was 500 B.t.u. per cu. ft. and the net heat value, 456.

The air fuel ratio for optimum power on town gas is 4.1:1 by volume; i. e., 80 per cent of air and 20 per cent of gas enter the cylinder during each induction stroke.

When considering engine power with town gas as compared with that developed on gasoline, differences of mean specific heat, latent heat, and specific gravity of fuel-air mixtures have to be allowed for. If dissociation is ignored, the flame temperatures of gasoline and gas are 3775 deg. Fahr. and 3850 deg. Fahr., and the gas mixture has an advantage of about 1.5 per cent as regards the resultant pressure. However, the calorific values of theoretically correct fuel-air mixtures are 95.0 B.t.u. per cu. ft. and 85.2 B.t.u. per cu. ft. for gasoline and town gas, respectively. This difference in calorific value of 10.3 per cent is a most important factor, and is the main cause of the reduced power output on town gas. Experimental determinations of power on gasoline and town gas with unmodified engines show—as would be expected—that the loss of power on typical small high-speed engines is greater than in the case of larger slow-running engines. In general, conversion to town gas results in a power loss of 15-20 per cent in the case of trucks with low-speed engines, and 20-30 per cent in the case of private cars and light vans. Efforts have been made to increase the power on town gas by increasing the compression ratio, advancing the ignition very slightly, and removing the "hot spot." These alterations give considerable improvement, and it is possible to obtain

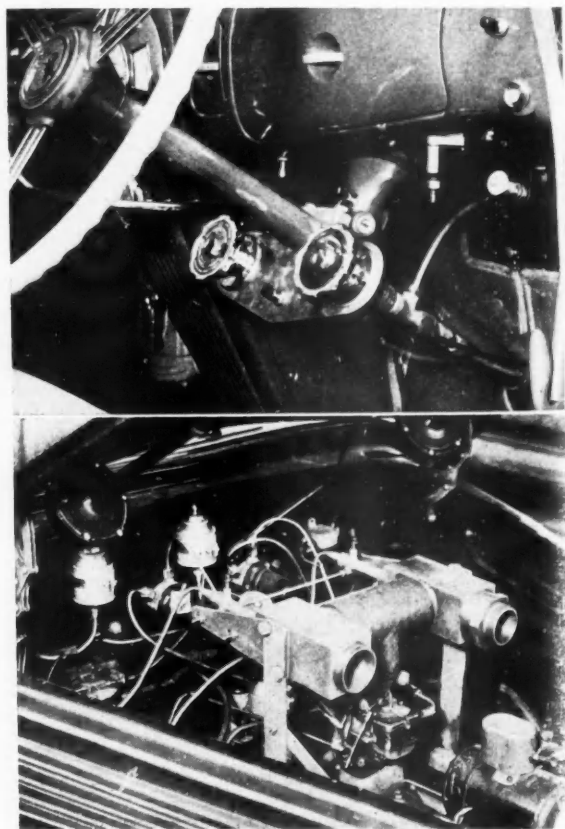
up to 90 per cent of gasoline power.

Private cars, laundry vans, commercial trucks and passenger buses are fitted with gas bags, and good results are obtained although the range is limited. Stand pipes, however, are available at convenient places, and in London alone at least 80 such pipes have been erected. A private car with an engine developing 48 hp. at 3800 r.p.m. usually is fitted with a bag containing 200 cu. ft. of gas. This gas costs about 20 cents, is sufficient for about 20 miles, and can be charged into the bag in about 7 min. The system is excellent for vans used in local delivery work and in such cases, not only solves the question of fuel supply, but shows a saving on running costs.

Sewage Gas

A number of municipal authorities utilize as motor fuel the gas obtained from the treatment of sewage by the activated sludge process. Activated sludge is the solid matter produced by aerating sewage, and consists of aggregates of micro-organisms in association with the solids produced by the flocculation of suspended and colloidal matter in the sewage. Sewage gas contains about 70 per cent of methane, the balance being mainly carbon dioxide. It has a calorific value of approximately 700 B.t.u. per cu. ft. and the cost of compressing, including labor and maintenance

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Conversion of a Lincoln V-12 to producer gas. The upper photo shows the control panel and the lower photo the air-gas mixers with hydraulic controls.



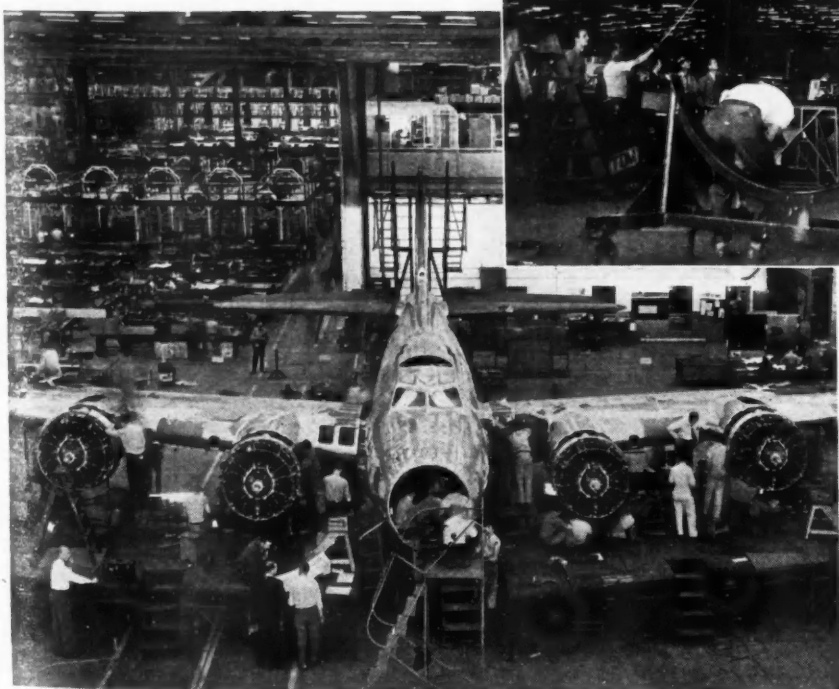
Vega built

Flying Fortresses

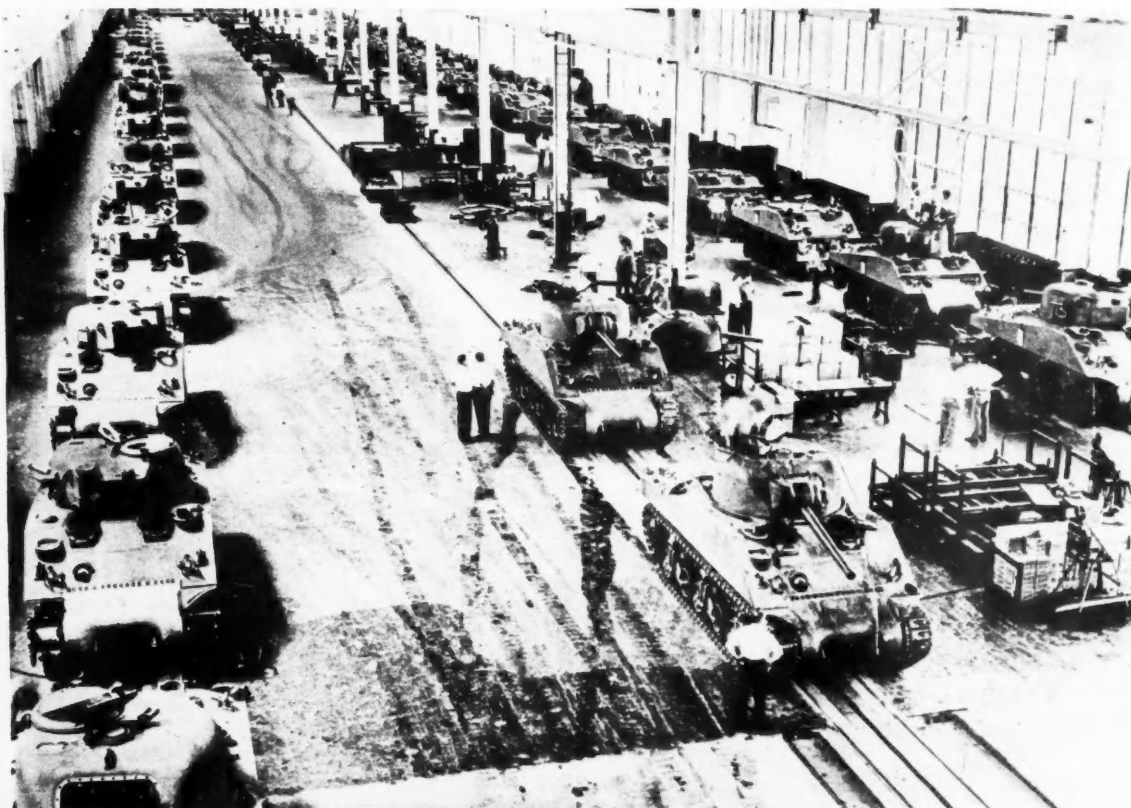
Working under a pooling agreement with Douglas and Boeing for the manufacture of B-17E Flying Fortresses, Vega is in production of these heavy bombers for the Army. The first delivery was made six months ahead of schedule.



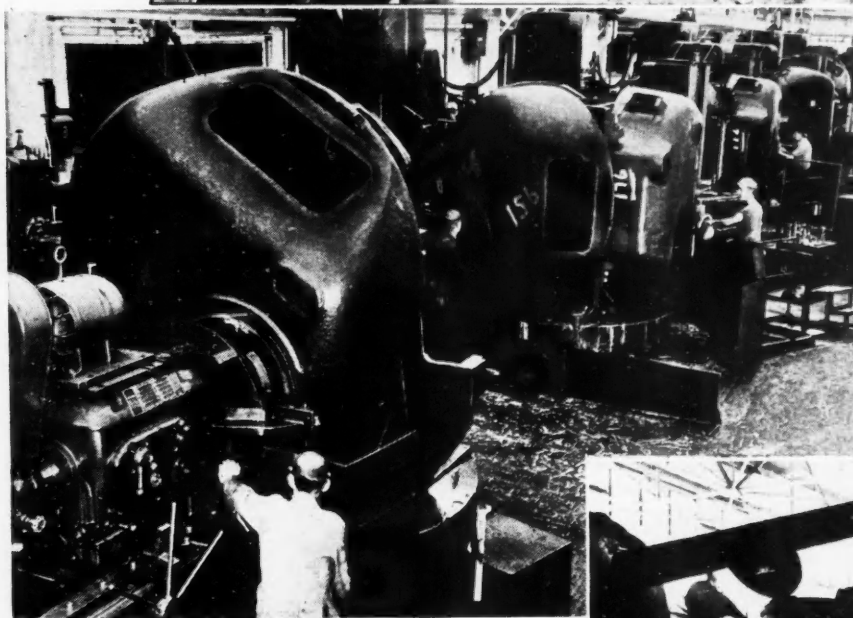
(Above) A completed B-17E fuselage being moved down the assembly line to the next station.



(Left) A Flying Fortress on the final assembly line at the Vega plant.



(Above) Six months ago this was rolling farmland and by July the Fisher Body Division of General Motors was shipping powerful all-welded M-4 tanks from this gigantic plant in train-load quantities

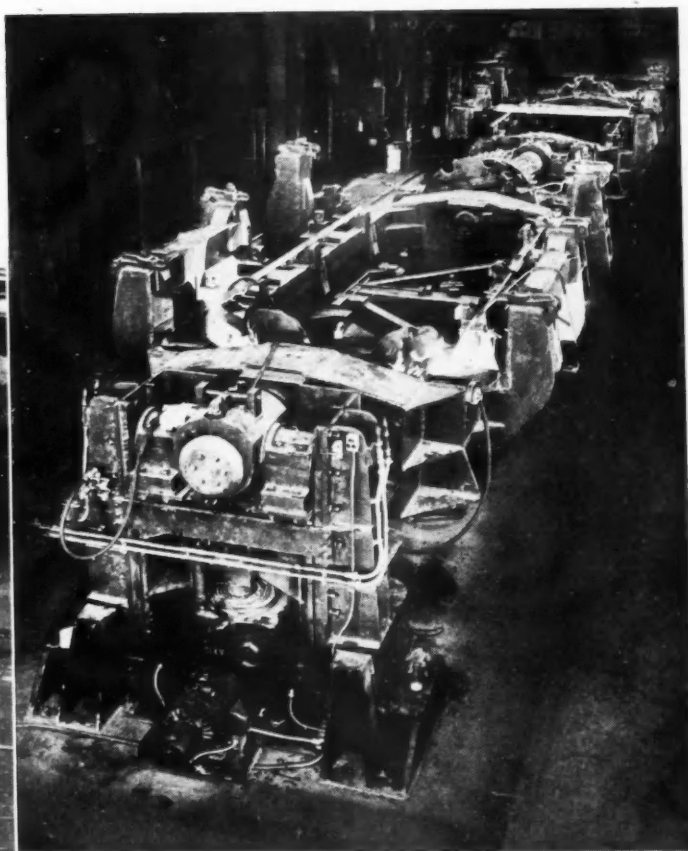


(Below) In America's newest M-4 tanks the hard-hitting 75-mm cannon is mounted on the turret.

(Above) Gun ports and hatches of the turrets are milled on this imposing battery of machines. To facilitate production, Fisher engineers devised a method, shown in the foreground, whereby two machines can work on one turret simultaneously. As a means of utilizing every moment of time, the fixture holding the turret is set on a turntable so that another turret is fixed in position on one side of the table while the other is being milled. The table then revolves and work begins on the second while the first is removed and another put into position.



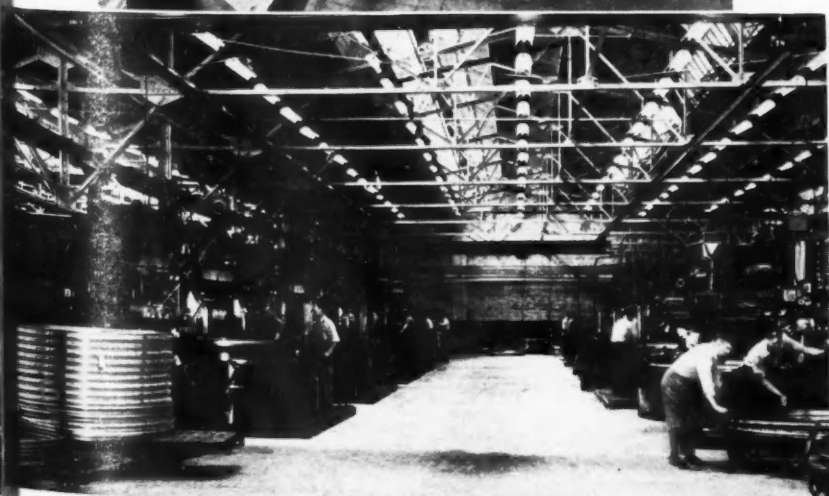
M-4 All-Welded Tanks by Fisher



(Above) This giant fixture, largest one known for the construction of all-welded tanks, was designed and built by Fisher Body to speed their production. It weighs as much as the completed 30-ton tank. It is so powerful that it grips the entire tank hull and revolves it in a complete circle so that workmen can always weld in a downward position no matter what portion of the hull they are working on. In addition to revolving, the fixture tilts sharply lengthwise either upward or downward.



(Top left) This turn-over fixture revolves through a complete circle to permit welders to work in a downward position, which not only results in faster welding but also produces better welds. The rear top plate of the tank is being welded here.



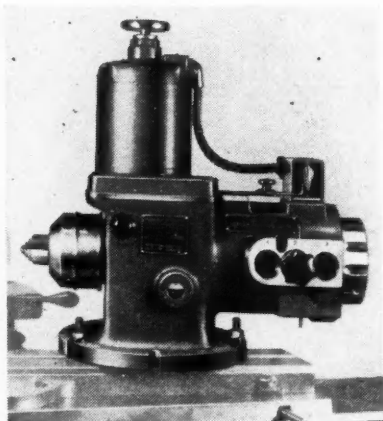
(Left) Due to the shortage of vital machine tools, Fisher built the vertical boring mills for machining the turrets and now is producing them in sufficient quantities to supply the needs of several other tank builders. A battery of the vertical boring mills is shown at the left.

MEN and MACHINES

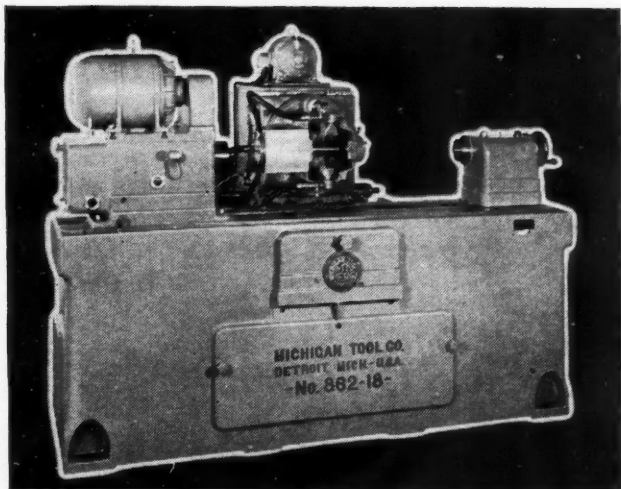
A NEW Pratt & Whitney deep hole drill sharpening attachment, developed to sharpen single-lip drills with straight or helical chip grooves, will handle drills ranging in diameter from $\frac{5}{8}$ to 2 in.

The attachment can be clamped on the standard table of a universal cutter grinder, or on other grinders of similar design. Although it was designed primarily for sharpening step drills, it has provisions for sharpening with equal efficiency V-shaped drills, or other cutting tools of similar shape. By inserting a removable cam roller in one of three grooves in a cylindrical cam, it is possible to choose the correct cam action for any drill retained in the hollow spindle.

Another drill sharpener for drills with diameters from $\frac{3}{16}$ to $\frac{5}{8}$ in. is also available.

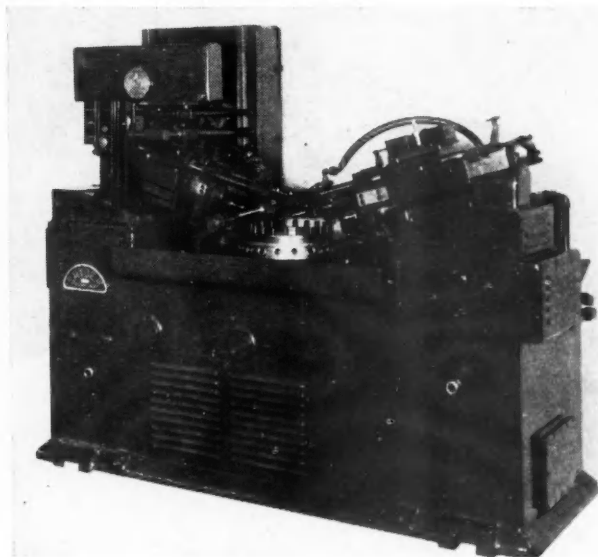


This Pratt & Whitney deep hole drill sharpening attachment is designed to handle drills ranging in diameter from $\frac{5}{8}$ to 2 in.



The new Michigan 862 Series of gear finishing machines employing the crossed-axis principle can handle gears as small as $2\frac{1}{4}$ in. in diameter.

Snyder Hydraulic Milling Machine designed especially for drilling oil holes through the trunnions of a reduction gear carrier ring.



FOLLOWING the recent announcement of a new 865 series of crossed-axis gear finishing machines for unusually large gears, the Michigan Tool Co., Detroit, Mich., has announced the 862 Series available in two sizes.

The flexibility of the machines permits the application of the crossed-axis principle of gear finishing to a wide range of gear sizes. Gears as small as $2\frac{1}{4}$ in. in diameter may be finished with the 862 Series machines. Face widths up to 20 in. can be accommodated on long or large diameter shafts, thus avoiding several probable errors.

DESIGNED especially to drill oil holes diagonally through the trunnions of a reduction gear carrier ring, a new

hydraulic drilling machine, built by the Snyder Tool & Engineering Co., Detroit, is said to effect a production increase of 700 per cent over what could normally be expected by customary methods.

The machine consists of three main parts—the fixture table and indexing mechanism, and two, two-spindle, hydraulically operated drill units. Constant velocity hydraulic cylinders actuating a Geneva index mechanism produce a shockless rotation of the fixture table through 20 positions. The drill spindles are supported by ball bearings and are equipped with bushing plates with overhanging guide pins.

The work cycle of the machine is semi-automatic. The electrical control mechanism, mounted at the left rear of the machine, includes a tell-tale dial which shows the operator at which part of the automatic cycle the machine is operating. If a tool should break, or if an extremely dull tool is used, the machine shuts off automatically.

Definitely designed for a single purpose, the machine is used to drill 20 0.078-in. holes. Drill finish is said to be satisfactorily smooth.

EMBODYING several new design features, Model 100 hydraulic extruding press, built by the Beatty Machine and Manufacturing Co., Hammond, Ind., is actuated by a double-acting hydraulic cylinder which eliminates outside pull-back cylinders.

The cast-steel material cylinder is lined with a renewable heat-treated, pressure-tight iron liner. The com-

(Turn to page 84, please)

Material Shortages Hamper War Production

**Lack of Alloy Steels Still a Major Drawback to Output;
Wood, Other Less Scarce Materials, Find Many New Uses**

Although the conversion of the automotive industry to war production has been practically completed, serious material shortages are beginning to hamper the output of war equipment and some plants have had to curtail their operations due to lack of parts or material. The situation is particularly acute as regards alloy steel, copper, brass, tin, tungsten and aluminum, according to the monthly report of the WPB Bureau of Industrial Conservation.

In a recent tour of Michigan factories, Lieut.-Gen. Wm. S. Knudsen said that the distribution of necessary materials to war plants is the main problem now facing industry. He urged the use of substitutes for vital materials wherever possible. He said the aluminum allocation was fairly well under control but that it is a tremendous task to distribute other critical materials among the nation's vast war industries.

Robert R. Nathan, chairman of the WPB Planning Commission, asserted recently that raw materials will be the biggest limiting factor in war production. It is too late for major expansion of raw material mining and processing facilities because the material required for such facilities, like steel and copper, would be competing with vital material needs of weapons and vehicles for the armed services. In fact, many war production plants running on a three- and four-shift basis may have to cut their operations to one and two shifts because of material shortages. The nation's fabricating capacity has reached the point where it exceeds the raw material supply. Many new plants have been placed in production in the last six months and other plants are operating more intensively. In many cases this has exhausted material stockpiles and there is not enough to go around. Hence, the resultant curtailment. Nathan said the aim of the WPB is to maintain a balanced program. There is no use piling up inventories of semi-fabricated goods when the end product cannot be completed for lack of some other part or parts.

A shortage of alloy steel forced the Chevrolet Gear & Axle Division of General Motors at Detroit to suspend production early in July. This in turn caused a curtailment in production at the Yellow Truck & Coach Mfg. Co.,

Pontiac, one of the largest producers of military trucks. Chevrolet supplies Yellow Truck with half its axle requirements.

"We believe the shortage may last two weeks, possibly four," said R. J. Emmert, Yellow Truck vice president and factory manager, in explaining the reduction in production to workers laid off by the shortage. "Timken-Detroit Axle Co. has been supplying part of our needs but they also are running short. The Quartermaster General's office and other officials in Washington are doing all they can to get steel but it is being diverted to other uses which are considered more vital."

In a letter to Donald M. Nelson, chairman of WPB, asking that the armed forces cease using 2,500,000 tons of steel per year for temporary barracks and warehouses, Walter Reuther, director of the General Motors Dept. of the UAW-CIO, said that lack of steel was causing a "creeping paralysis" on vital war industry plants. Reuther said that GM had announced

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Simplify Machine Tool Specifications

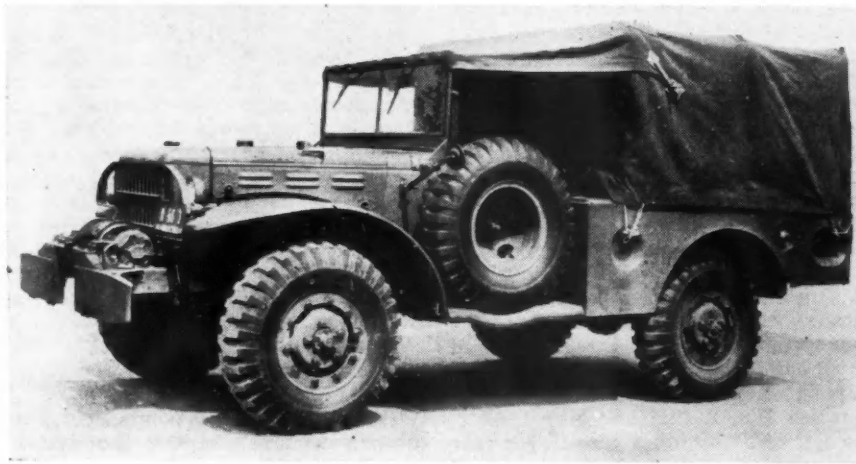
In a move to eliminate bottlenecks in the manufacture of machine tools, the WPB recently prohibited the production of machine tools calling for special electrical specifications. Issuance of the order (L-147) is expected to expedite increased production through simplification of manufacturing specifications. Orders placed by the Army, Navy, or Maritime Commission for their own use, and orders authorized by the WPB are exempt.

To Operate Plants

United States Rubber Company has announced receipt of contracts from the War Department for operation of two ordnance plants in Wisconsin. This brings to six the number of ordnance facilities which the company has been authorized to operate. Under the various contracts, the company will make ammunition and explosives, and load shells.

Peter S. Steenstrup

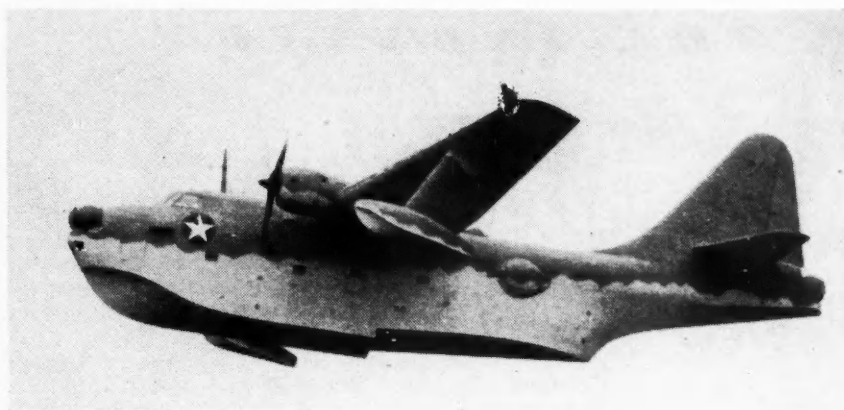
Peter S. Steenstrup, 68, former vice-president and general manager of General Motors Export Corp., died recently at San Mateo, Cal. He was Pacific Coast manager for Buick at the time of his death.



Army's New 3/4-Ton Truck

The 4 by 4 half-ton truck, long a standby of the Army's motorized divisions, will eventually be replaced by a new 3/4-ton model furnished in four body styles: a command car, a weapons carrier, a carryall, and an ambulance. Designed with many parts which are interchangeable with parts on the 1/2-ton model, the new type incorporates a lower silhouette, a shorter wheelbase, and larger tires—9.00-16's instead of 7.50-16's. The wheelbase on the new weapons carrier and the command car is 98 in. in comparison with 116 in. on the 1/2-ton truck, on the carryall—114 instead of 116 in., and on the ambulance—121 instead of 123

in. Although both trucks are driven by the same 230-cu. in. engine, the pulling power of the 3/4-ton vehicle has been increased by a change in the rear-axle gear ratio. The gas tank on the new truck holds 30 gal. compared with the 25-gal. capacity of the 1/2-ton model. The truck can be fitted with the split-rim type of wheel which permits the use of the "run-flat" or combat-type tires. When these tires are shot by bullets, the vehicle can still keep going long enough to get it out of danger. A cross section of this type appeared in the July 15th issue of *Automotive and Aviation Industries*.



Boeing Sea Ranger

Designed for extended bombing and scouting operations, the Sea Ranger, a new long-range experimental flying boat built by the Boeing Aircraft Co., is expected to have a longer range and to carry a heavier bomb load than any Naval plane now in service. Known as the XPBB-1, the new craft is powered by two Wright Cyclones. Living accommodations for a ten-man crew are provided.

Industry Awaits Labor Board Decisions

Little Steel Verdict Foreshadows Only Token Boost for Auto Workers; Sporadic Strikes Quickly Settled

If the wage stabilization policy of the War Labor Board as enunciated in the Little Steel case is applied to the pending decision in the General Motors contract dispute, and similarly to the Chrysler and Ford cases, it is doubtful if the automotive workers will receive anything but a token wage boost. However, the Little Steel decision does hold the threat to the automotive companies of a maintenance of membership clause and the checkoff for those members in good standing. The UAW-CIO has asked for a union shop from both General Motors and Chrysler and is endeavoring to have Ford retain the dues checkoff which became effective in August, 1941, under the first UAW-CIO contract with the company.

The 5½-cents-per-hour (44 cents per day instead of the \$1 asked) wage increase granted to the SWOC from the four members of Little Steel was based on an opinion written by Dr. George W. Taylor, of WLB, former GM umpire. Between Jan. 1, 1941 and May 1, 1942, the cost of living index rose 15 per cent compared to a wage increase of 11.8 per cent during that period for steel workers. These workers therefore were entitled to a raise of 3.2 cents per hour, based on the average wage of \$1 per hour in the steel industry. However, in the interest of equity, Dr. Taylor said the steel workers were entitled to a further increase of 2.3 cents per hour, making the total 5½ cents per hour. This latter opinion was based on the fact that the steel dispute was certified to the WLB in February, two and one-half months before the president's mes-

sage of April 27 to Congress establishing a national economic policy. Therefore, he said the steel workers were caught by a change in rules in the middle of the game. He also stated that there had been a greater rise in the cost of living in steel towns.

The case for the automotive industry was stated by Herman L. Weckler, vice president of Chrysler Corp., in repaying to the union's 13 contract demands. He wrote the WLB, "There can be no reasonable basis for increasing the wage level of people who already are the best paid workers in the whole country, and this is true whether the increase results from a general wage increase or through raising rates in different classifications. The effect is the same, to accelerate the cost-of-living spiral, to widen the differential between automobile wages and wages in other industries, and to further complicate the wage and manpower stabilization programs."

The statement also pointed out, "At the present time Chrysler Corp. is engaged practically exclusively in making war materials on a great scale for the U. S. government as prime contractor, or subcontractor. Its war contracts in the main contain escalator clauses relating to wages or are on the basis of cost plus a fixed fee. Accordingly, increases in wages, if this board imposes them, must be passed on to the government and the taxpayer."

Average hourly earnings for employees in 93 manufacturing industries during April were \$.819, according to

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Business in Brief

*Written by the Guaranty Trust Co.,
New York, Exclusively for AUTO-
MOTIVE AND AVIATION INDUSTRIES*

Somewhat broadened fluctuations in general business activity have been indicated. The index of *The Journal of Commerce*, without seasonal adjustment, for the week ended July 18 stands provisionally at 124.1 per cent of the 1927-29 average, as against 121.8 for the week before, and is only half a point below the 1942 peak recorded in January. The seasonally adjusted index of *The New York Times* for the week ended July 11 fell to 127.0 per cent of the estimated normal from 129.3 for the preceding week.

Department store sales during the week ended July 18, as reported by the Federal Reserve Board, were 5 per cent greater than a year ago, as compared with a similar excess of 10 per cent shown a week earlier. For the year to that date, the total is 13 per cent above the corresponding amount in 1941.

Railway freight loadings in the week ended July 18 totaled 857,067 cars, 0.2 per cent more than the number for the preceding week but 4.7 per cent below that of a year ago.

Electric power output rose more than seasonally in the same period and was 11.4 per cent greater than a year ago, as against a corresponding excess of 7.9 per cent reported a week earlier.

Crude oil production during the week ended July 18 averaged 3,713,400 barrels daily, 56,000 barrels above the figure for the preceding week but 129,400 barrels less than the average output recommended by the Office of the Petroleum Coordinator.

Average daily production of bituminous coal during the week ended July 11 was 1,817,000 tons, as compared with 2,023,000 tons for the week before and 1,583,000 tons a year ago.

Engineering construction contracts awarded during the week ended July 23 amounted to \$148,171,000, or 28 per cent less than the corresponding sum last year, according to *Engineering News-Record*. For the current year to that date, the total is 61 per cent above the comparable 1941 figure.

Professor Fisher's index of wholesale commodity prices for the week ended July 17 stood at 108.2 per cent of the 1926 average, as against 108.4 for the preceding week, the highest level reached this year.

Member bank reserves rose \$509 million during the week ended July 22, and estimated excess reserves increased \$230 million to a total of \$2,300 million. Business loans of reporting members increased \$25 million in the preceding week and stood \$493 million above the total a year earlier.

40 YEARS AGO

In New York City it was reported some time ago that three gasoline motor ash carts were building for the use of the street cleaning department. A recent report has it that no suitable vehicle could be secured. Less attention has been paid to the commercial vehicle in the United States by automobile manufacturers than in England, where some makers have devoted themselves exclusively to the commercial vehicle, and others who have gained prominence as builders of pleasure cars are now entering the wider field of the truck, the van, the delivery wagon and the omnibus. From *The Horseless Age*, July 30, 1902.

FAMILIAR NAME ON



NEW ASSEMBLY LINES

NOW it's aircraft engines where sedans "used to grow"...or plastics instead of critical metals...or welding replacing rivets. The man on the assembly line has *seen* the changes taking place—one after another.

One thing, though, hasn't changed—merely "changed over" to war production. In the Torrington Needle Bearing, veteran production men recognize an old familiar name. For this unique bearing is proving its adaptability anew, in applications where its advantages mean more today than ever.

Its ease of installation, for example,

is cutting assembly time...enabling green hands to "catch on" more rapidly, experienced hands to work with the speed and efficiency war production schedules demand.

Every feature of the Needle Bearing, in fact, is filling some vital wartime need. Its small size is saving space and critical materials; its simplified design is eliminating extra parts and assembly steps; its low coefficient of friction, assuring smooth performance...high capacity and efficient lubrication, reducing the need for replacement or maintenance attention.

And so it is easy to understand why the Torrington Needle Bearing is in service today on new assembly lines all over America—assembly lines geared to production-for-Victory.

FOR INFORMATION concerning capacities and sizes, send for Catalog No. 107. Or consult a Torrington engineer. He is an expert in adapting the Needle Bearing's unique advantages to specific problems.



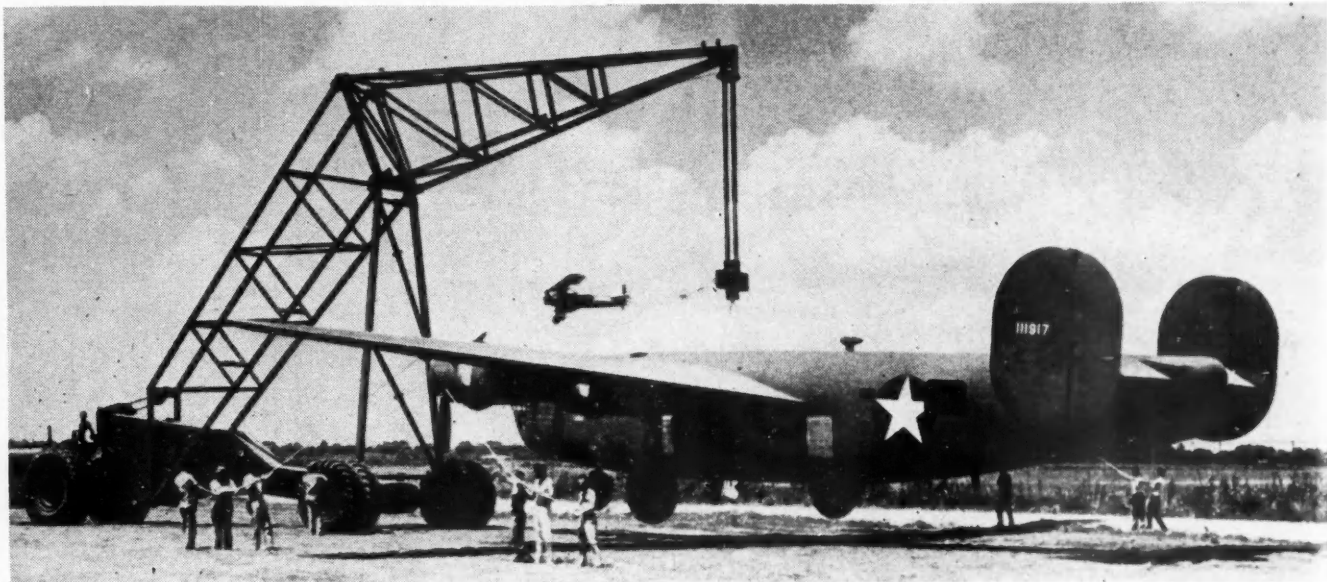
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Cleveland	Seattle	Chicago	Los Angeles
San Francisco	Toronto	London, England	

TORRINGTON NEEDLE BEARING

Every feature fills a wartime need



Giant Mobile Crane

This giant crane, capable of lifting 60,000 lb. and of traveling at a speed of 18 mph, has been developed by the Army Air Forces at Wright Field, Dayton, Ohio. No mere

overgrown tow truck, the crane, driven by a rear-mounted engine, is shown lifting a Consolidated B-24 bomber. It is expected to be especially useful in cleaning up wreckage.

Pig Iron Deficit Rivals Dearth of Scrap

WPB Seeks to Step Up Ore Mining, Increase Number of Ore Boats, Add 11 Million Tons to Furnace Capacity

By W. C. Hirsch

Were it not that the iron and Steel Branch of the War Production Board had laid so much emphasis on the gravity of the scrap supply situation in its recommendation that the country's ingot capacity be stepped up from the present 88,569,970 tons to approximately 100,000,000 tons a year by next summer, it would hardly have attracted the attention which it did.

The march of events has not only definitely shelved for the time being all consideration of the post-war set-up of the steel industry, but the American Iron and Steel Institute is also revising its capacity ratings, which should narrow the gap between production estimates based on actual wartime performance and appraisals of potential output according to traditional methods, thereby eliminating one of the causes that have contributed to much of the divergence of views on the subject of whether steel capacity is or is not adequate.

The Iron and Steel Branch report to the War Production Board makes it clear that where the shoe really pinches is in the supply of steel-making material. Much of the prevailing confusion results from the constant labeling of this phase of the situation as: "the scrap problem" or "the scrap famine." This is misleading because a major cause of the trouble seems to be the tight supply of pig iron. This the

Iron and Steel Branch of the War Production Board would alleviate by stepping up iron ore mining, by adding to the fleet of Great Lakes ore carriers, and by adding approximately 11 million tons to the country's blast furnace capacity.

The difficulties that are to be anticipated in connection with the carrying out of this program, especially so in view of correspondingly ambitious plans for increasing steel ingot capacity, are that it will take considerable material and labor, needed perhaps just as urgently in the direct production of armament material, and the time factor. Considerable risk, of course, is incurred in times like these in carrying out any plan not expected to be completed before the summer of the following year.

Aside from the scrap that results from steel mill and fabricating plant operations, it is impossible to make any estimate of what tonnages will be available. No one can tell how much more can be resurrected from automobile grave-yards or what tonnage of farm scrap will be available next year, when conservation and reconditioning may be expected to keep many an implement, that in more serene days would have been scrapped, operating.

It is possible, however, to calculate the yield of additional iron ore mines and the output of additional blast fur-

(Please turn to page 69)

Committee Studies Rubber Conservation

Standard classifications, specifications, and tests for both natural and synthetic rubbers are being set up by a joint committee of the SAE and the ASTM. Interest is now centered in rubber for automotive and aeronautical purposes other than tires. Thus far the committee has reduced from several hundred to less than 100 the number of rubber compounds. It is believed that the new classifications will allow manufacturers to conserve rubber and to make substitutions when a shortage of a particular type appears.

CALENDAR

Conventions and Meetings

SAE West Coast Transportation and Maintenance Meeting, Los Angeles, Aug. 20-22
National Petroleum Association, Atlantic City, Annual Mtg.Sept. 16-18
SAE National Aircraft & Production Mtg., Los AngelesOct. 1-3
Natl. Safety Council, Chicago, Annual Mtg.Oct. 5-9
Natl. Metal Congress & Exposition, ClevelandOct. 12-15
American Welding Society, Detroit, Annual Mtg.Oct. 12
American Society of Tool Engineers, War Production Conference, Springfield, Mass.Oct. 16-17
SAE National Fuels & Lubricants Mtg., TulsaOct. 22-23
Natl. Lubricating Grease Inst., New Orleans, Annual Mtg.Oct. 25-29
Natl. Industrial Chemical Conf. & Exposition, ChicagoNov. 17-22
American Petroleum Inst., Annual Mtg., ChicagoNov. 9-13
SAE War Production-Engineering Mtg., DetroitJan. 11-15

his time - and so are you !

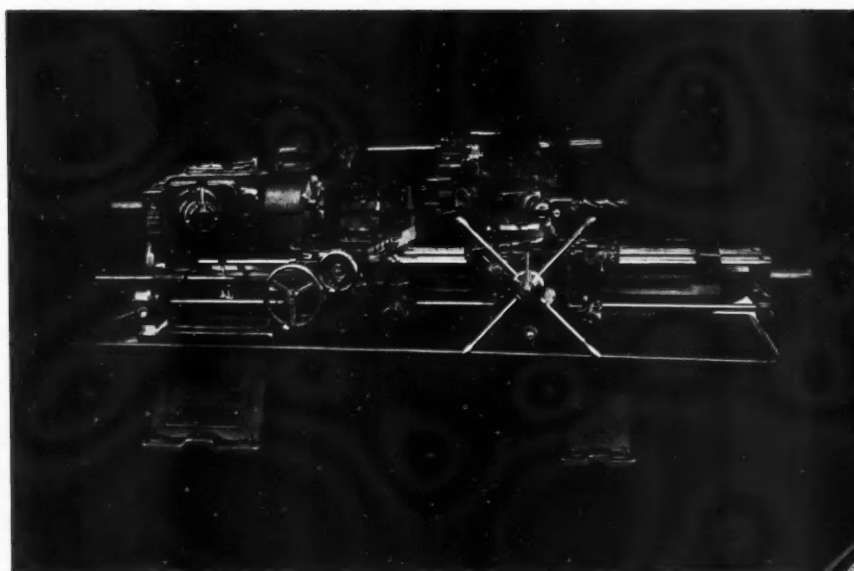
FREDERICK W. HOWE was ahead of his time, and so are you, when your plant is equipped with modern Jones & Lamson Turret Lathes.

Modern Jones & Lamson Turret Lathes are ahead of the times in many ways. Into these new machines have been built ample reserves of speed, rigidity and useful power to enable you to take full advantage of every improvement in hard alloy cutting

tools — available today *or liable to become available in the immediate future.*

Thus Jones & Lamson Turret Lathes can help you meet the urgent demands of immediate wartime production and still be available to help you in the hard years that lie ahead.

Among other reasons, this is why it pays to put your production problems up to Jones & Lamson. Write today, inclosing blueprints and ask for illustrated catalogs.



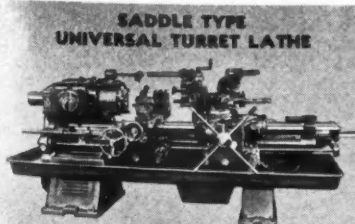
7A Jones & Lamson Saddle Type Universal Turret Lathe with standard chucking equipment.

& LAMSON MACHINE COMPANY *Springfield, Vermont, U. S. A.*

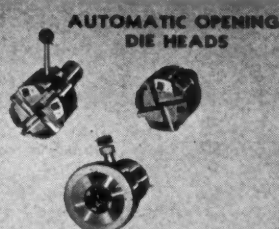


PROFIT PRODUCING
MACHINE TOOLS

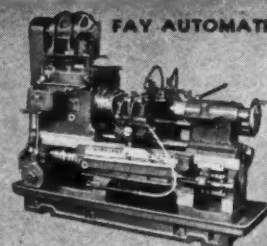
MANUFACTURERS OF: RAM & SADDLE TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC THREAD GRINDING MACHINES . . . COMPARATORS . . . AUTOMATIC OPENING THREADING DIES AND CHASERS



SADDLE TYPE
UNIVERSAL TURRET LATHE



AUTOMATIC OPENING
DIE HEADS



FAY AUTOMATIC LATHES



Keep 'em Flying

with

HOLTITE



Strong, accurate, uniform and completely dependable, HOLTITE fastenings and parts, regular and Special, are precision-made to aviation requirements and government specifications. On your next order specify HOLTITE time-saving, rugged fastenings.

Our Engineering and Technical Staffs invite inquiries on all fastening problems.

**CONTINENTAL
SCREW CO.** New Bedford, Mass., U.S.A.
Warehouse at Detroit Mich.

Chrysler Marine Propulsion Unit

The Chrysler Division of the Chrysler Corp. is now in production of this new-type marine propulsion unit which can be attached to any flat bottom carrier. Once in place, the unit becomes an integral part of the barge. In the photograph are shown two units towing a heavily-loaded steel barge during a test.

Order Inventory of New Commercial Vehicles

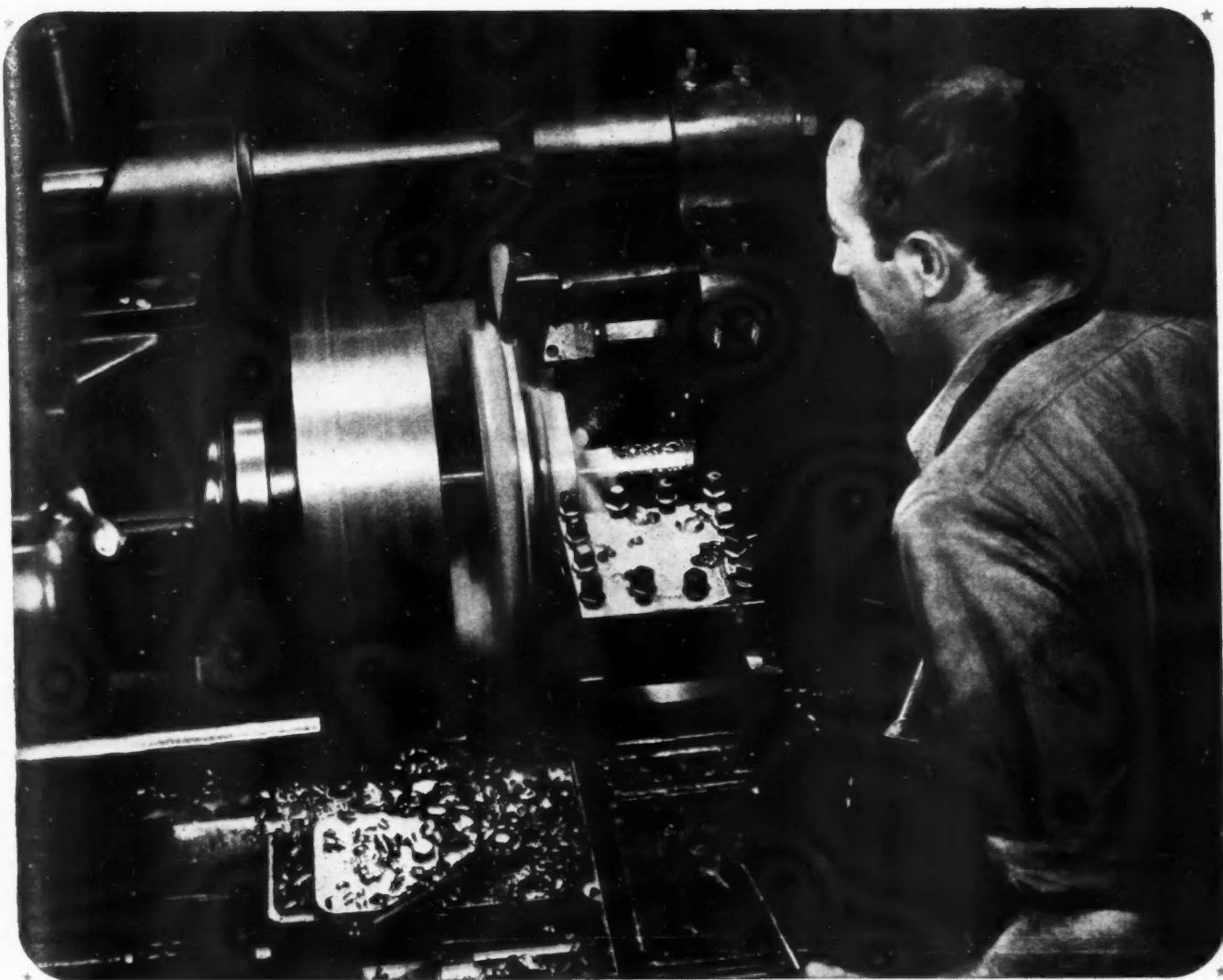
A country-wide inventory of new commercial motor vehicles has been ordered by the War Production Board in an effort to tighten the rationing program that began March 9. A shortage of certain types of trucks and the increasing demands of the Army and the Navy make it imperative to determine the location and type of every new commercial vehicle in the country. The inventory, ordered under Supplementary General Conservation Order M-100-A, will be compiled by WPB's New Commercial Vehicle Inventory Unit, located at 200 Varick Street, New York City.

Since March 9, a total of 55,551 vehicles in all categories has been released for the use of civilians and holders of Government Exemption Permits. During this period civilians received 5048 light, 12,848 medium, and 4511 heavy trucks, 3141 trailers, and 446 miscellaneous vehicles; GEP holders received 9299 light, 12,282 medium, and 3744 heavy trucks, 1038 trailers, and 3194 miscellaneous vehicles (station wagons, ambulances, and hearses.)

ADVERTISING

Incorporation of Kircher, Lytle, Helton and Collett, Inc., to handle all types of advertising and promotion service was announced recently. The officers are: J. Horace Lytle, president; Ralf C. Kircher, vice president; Carter B. Helton, treasurer and business manager; and Robert Collett, secretary.

Harry Mitchell, formerly vice-president of J. Stirling Getchell, Inc., and manager of the Detroit office, where he directed the Plymouth and De Soto accounts, has joined the Chicago office of J. Walter Thompson Co. as an account executive.



TWO TOOL STEELS CAN CUT AS CHEAPLY AS ONE

WHAT'S more important, two tool steels can cut twice as fast as one, and speed is the prime urgency in war production.

But there are ways of increasing production beside installing more modern types of machine tools. A better tool steel, or one better suited to an individual job, can materially speed up the work your existing equipment is capable of doing.

Take the case of a big Detroit plant, using DBL High Speed Tool

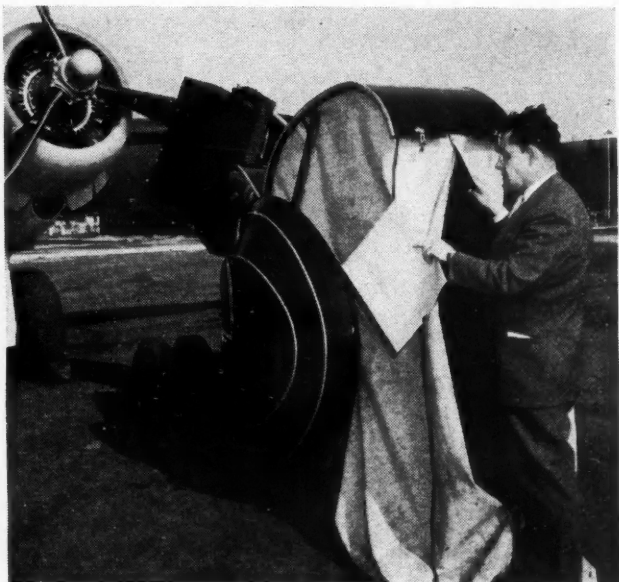
Bits instead of a high-tungsten variety, machining castings of X-1340 steel with a surface hardness of 33 Rockwell C, and a subsurface hardness of 26-28C. The DBL Tool Bits showed 30% increase in work done between grinds, running at 166 RPM against a previous speed of 100 RPM.

Our Service Staff is ready to help you team up tool steels with your production jobs, for more work done per machine. They'll show

you the best *alternate* steels, too, as a precaution in keeping the lines moving.



Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: PITTSBURGH, PENNSYLVANIA



Portable X-Ray Unit

Certainly no time is lost in the inspection of aircraft for structural defects when this portable X-ray unit goes to work. Designed at the Lockheed Aircraft Corp. plant in Burbank, Cal., by Tom Triplett of Triplett & Barton, the unit may be taken right onto the field. A darkroom, part of the outfit, permits speedy development of plates.

Seeks Permission to Retread Workers' Tires

Ford Motor Co. has asked the War Production Board for permission to retread the tires on the automobiles owned by the company's 110,000 workers with Thiokol, according to Charles E. Sorensen, vice-president and general manager. Ford chemists and tire experts tried out all kinds of synthetic rubbers, rubber substitutes and reclaimed rubber before deciding upon Thiokol as the best material for keeping the vehicles of the company's essential war workers in operation.

Ford would set up the equipment for the manufacture of Thiokol in the tire factory at the Rouge plant, utilizing tanks and vats made of wood or concrete and salvaged metal equipment in order not to draw upon critical materials. Thiokol is a polysulfide rubber made from sulphur, salt, and natural gas. The Thiokol Corp., of Trenton, N. J., holds the basic patents, but the Dow Chemical Co., of Midland, Mich., is licensed to make Thiokol commercially. Dow is completing a pilot plant at Midland for the manufacture of Thiokol for retreads, with eventual expansion of facilities there.

Ford plans to use two pounds of Thiokol per tire, which would give a tread one-tenth of an inch thick. This would be good for 4000 to 5000 miles of moderate driving at speeds below 40 m.p.h. Workers' tires would be inspected periodically and a retread applied as soon as the fabric began to show on the tires. Ford proposes to offer the plan, process, and methods to all of U. S. war industry if the government approves. Retreading would be done in Ford's tire factory.

Howard D. Colman

Howard D. Colman, president of the Barber-Colman Co., Rockford, Ill., died as the result of an accident late last month.

MEN

John Senn has been appointed assistant advertising manager of The Perfect Circle Companies, replacing Stanley Murray, who has been made purchasing agent of the Hagerstown plant.

Harry L. Wise, formerly sales engineer with Vickers, Inc., has been appointed president and general manager of Hydraulic Machinery, Inc.

H. B. (Ben) Orr has been elected vice-president in charge of sales of Universal Products Co., Inc., and G. E. Dunn made chief engineer in charge of all designs and applications of Universal Joints.

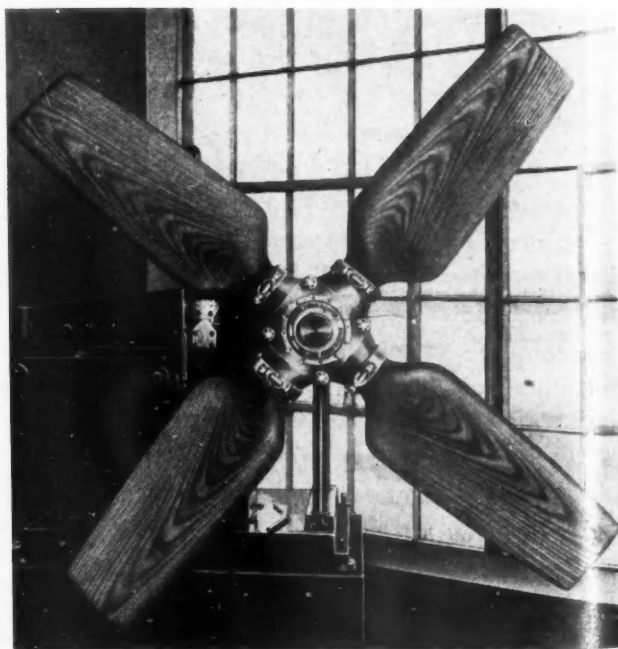
Joseph A. Elwood, until recently factory manager of the Hydraulic Division of the Sundstrand Machine Tool Co., has been appointed general works manager of the George Gorton Machine Co.

C. D. Manning, executive assistant to the president, has been appointed general sales manager of the Kellogg Switchboard

(Please turn to page 62)

Resin-Bonded Test Prop

Compreg wood propeller blades, manufactured by the Camfield Mfg. Co., Grand Haven, Mich., are formed in heated steel dies from layers of maple impregnated with a phenol formaldehyde resin. The finished product, with the density of a molded resin, is said to resist favorably all changes in atmospheric conditions. The propeller shown in the photograph is a standard Camfield adjustable-pitch testing propeller.



PUBLICATIONS

A new edition of the Federal-Mogul Engine Bearing Service Manual has just been published by Federal-Mogul Corp. The revised manual contains 90 pages and gives more thorough coverage of its subject. New sections of considerable value to service men have also been added.*

Cincinnati Milling and Grinding Machines, Inc., has issued a complete manual, M-1084, on the lubrication of Cincinnati milling, grinding, broaching, and lapping machines.*

The Williams Gauge Co. has issued Catalog No. 142 describing and illustrating its line of power plant equipment. It contains technical data on pump valves, water gauges, steam pump governors, gauge cocks, etc.*

A folder on the new Littlefuse Beryllium Copper Fuse Clips and Screw Terminals has just been issued by Littlefuse, Inc. It contains general and technical information and illustrations of the clips and screw terminals.*

Super Sight is the subject of a four-page catalog released by the Boyer-Campbell Co. It tells how this product combines magnification and properly directed light and is adapted to close inspection, fine assembly, and precision machining.*

A data sheet on taper splines has been issued by Barber-Coleman Co. It is No. 33.

McKenna Metals Co. has just issued a new catalog—42V—covering specifications and prices of Kennametal steel-cutting carbide tools and blanks. It is well illustrated, contains a visual index and information on the selection and design of tools and blanks, chip breakers, etc.*

A new data sheet giving descriptions and characteristics of Erie Suppressors has been issued by Erie Resister Corp. Charts showing suppression efficiency and life tests are included.*

Durez Plastics is the title of an 8-page folder by Durez Plastics & Chemicals, Inc. It gives the complete story of the manufacturing process from the raw materials to finished products and is written in non-technical style.*

The Di-Acro System of Metal Duplication Without Dies is the title of a booklet by O'Neil-Irwin Mfg. Co. It is well illustrated

(Please turn to page 60)



19 PLACES TO GET A 50% SAVING IN ASSEMBLY TIME

To back up your industry with a continuously plentiful supply of one of your most-in-demand items, a total of 19 screw manufacturers have been equipped to produce time saving, trouble-saving Phillips Recessed Head Screws.

Tremendous manufacturing capacity . . . nationwide distribution . . . are augmented by a corps of 150 sales engineers, qualified to help you get the most from Phillips. In the average case, they can show you how to save 50% in assembly time — eliminate operations, prevent accidents, eliminate burrs, get stronger fastenings.

The shape, taper and depth of the Phillips recess were determined after thousands of tests. The drivers maximum turning power is utilized without sacrifice of strength in the screw head . . . without danger of shearing the metal or breaking the bit. That's why the majority of units turned out by leading aviation and automotive concerns are Phillips-assembled.

*SPEED PRODUCT DELIVERIES
BY SAVING ASSEMBLY TIME...
SPECIFY PHILLIPS AND
SAVE 50%.*



Phillips Recessed Head Screws

WOOD SCREWS • MACHINE SCREWS • SHEET METAL SCREWS • STOVE BOLTS • SPECIAL THREAD CUTTING SCREWS • SCREWS WITH LOCK WASHERS

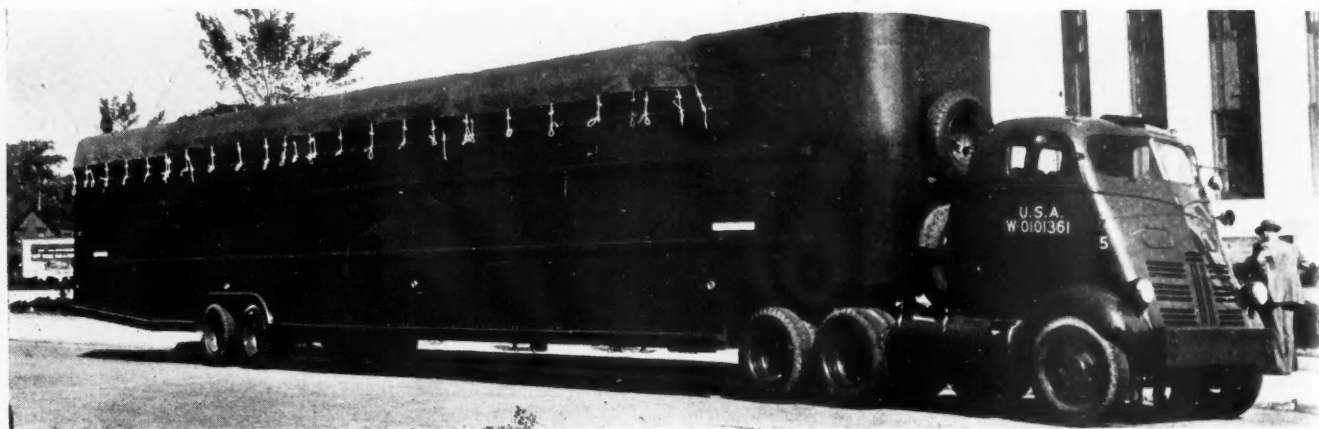


**19 SOURCES
of SUPPLY**

Order stronger, cost-cutting Phillips from any of these sources

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
Whitney Screw Corp., Nashua, N.H.

New England Screw Co., Keene, N.H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N.Y.
Pawtucket Screw Co., Pawtucket, R.I.
Pheoli Manufacturing Co., Chicago, Ill.
Russell, Burdall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.



"Converted"

TO SERVE OUR
Converted CUSTOMERS

● Wartime conversion of automotive plants found The Dole Valve Company already converted to the same program.

As an established supplier under the old order we still consider the automotive industry a natural market. Whenever priority conditions or schedules permit, we shall find ourselves doing business with many an old customer.



**DOLE
THERMOSTATS**



AVIATION Standard FITTINGS



**DOLE
PRIMERS**



DOLE BI-METAL

DOLE

THE DOLE VALVE COMPANY, 1901-1941 Carroll Ave., Chicago, Ill.

PHILADELPHIA • DETROIT • LOS ANGELES

Trailer for Airframe Parts

The Ford Motor Co. has adopted this type of trailer to carry airframe parts from Willow Run to assembly plants on the Southwest. The giant trailer is 63 ft. 6 in. long, 8 ft. to 10 in. wide, and 12 ft. 6 in. high. Overall length with the tractor is 72 ft. 7 in. The trailer weighs 22,000 lb., the tractor, 9300 lb. The trailer is designed to hold the complete wing and fuselage sections for B-24 Consolidated bombers. Two trailers accommodate a complete bomber airframe, except the motors.

Tubeless Tire

Announced by Goodrich

Invention of a heavy-vehicle tubeless tire was announced recently by The B. F. Goodrich Co. The use of a specially-designed locking member which retains the air in the casing is said to be the secret of the new development, which saves approximately seven per cent of the rubber used in the conventional casing, tube, and flap ensemble. Further details have been withheld.

Publications

(Continued from page 58)

and contains a complete outline of the Di Acro system.*

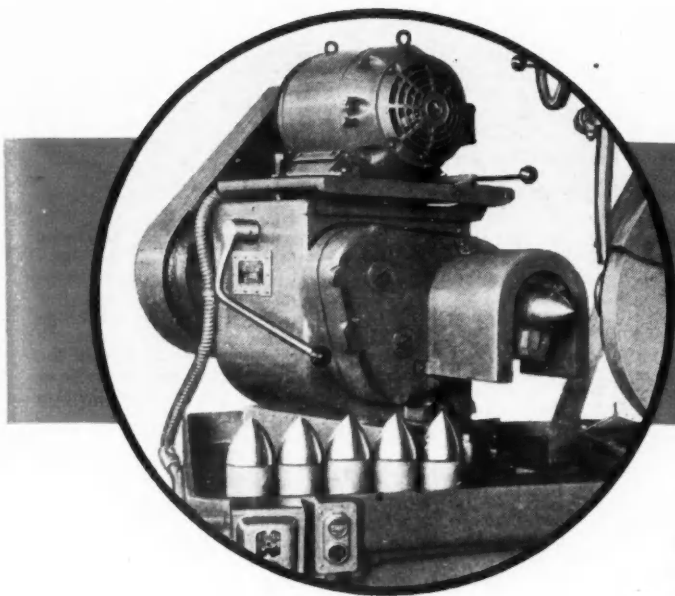
J. I. Case Co. has issued an attractive booklet on old wood engravings. It contains illustrations of gas engines, threshers, saw mills, etc., and can be secured by writing to the company at Racine, Wis.

American Lava Corp. has issued in booklet form a reprint of an article on ceramic high-frequency insulators.*

Radial Drill Presses Are Meeting Today's Industrial Demands, is the title of a folder by Walker-Turner Co. It gives information, illustrates and gives specifications of its models RD1170 and RD1175-J. Another folder describes, illustrates and gives specifications for the Walker-Turner 1100 Series 20-inch drill presses.*

Catalog No. 16 describing South Bend 16-inch precision lathes has just been issued by South Bend Lathe Works. The catalog is illustrated and gives information on its 16-inch toolroom lathes and 16-in quick change gear lathes.*

* Obtainable through editorial department, AUTOMOTIVE and AVIATION INDUSTRIES. Address: Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.



*on Grinding
jobs like this*

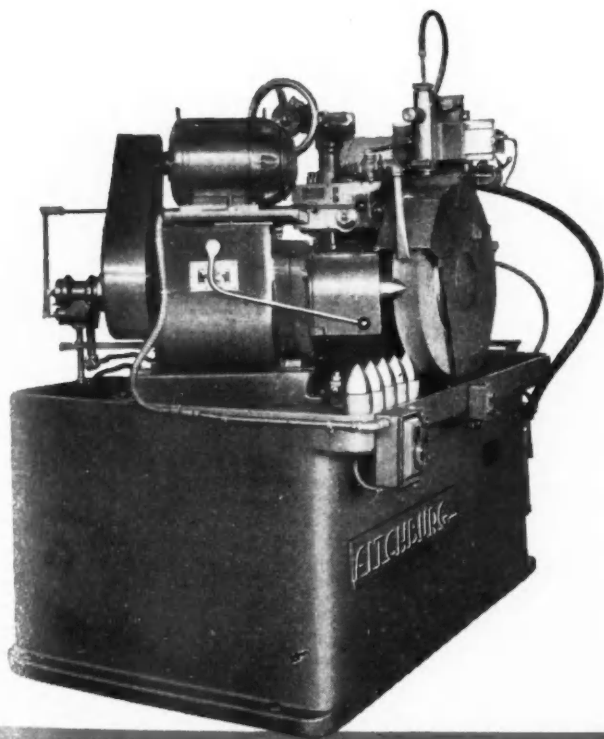
. . . FITCHBURG OFFERS SPECIAL ADVANTAGES IN MASS PRODUCTION

This Fitchburg special Chucking Grinder with a heavy duty headstock, is designed for grinding the ogive of armour piercing shells. The wheelhead is a Fitchburg Standard Bowgage Unit carrying a

24" x 3½" face wheel. A hydraulic form truing device is mounted on the wheelhead.

To operate this machine the operator places the shell in the open jaw chuck, then, by pushing a ball lever forward, closes the chuck, clamping the work piece at a definite distance from the bottom of the shell. To start the work rotation, operator depresses the long lever and pushes the button to start the automatic grinding cycle.

When installing special precision grinding equipment, it is well to remember that the Fitchburg Bowgage Grinding Wheelhead is a standard unit. It can be remounted on standard machines, or on new special bases, for operations other than the one originally specified. This feature protects your investment.



*. . . Write today
for folder giving
complete details.*



FITCHBURG GRINDING MACHINE CORP.

FITCHBURG, MASSACHUSETTS, U. S. A.

Manufacturers of—Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

MEN

(Continued from page 58)

& Supply Co., and **Robert M. Kalb**, previously assistant chief engineer, has been named chief engineer.

C. W. Meyers, assistant manager of the metallurgical department since 1937, has been appointed special representative in the aviation field with the manufacturer's products division of the sales department of American Steel & Wire Co.

Fred S. Carpenter has been appointed general manager of the tire division of U. S. Rubber Co., succeeding **Emmet Sheahan**, who recently was named assistant to the president. **Howard N. Hawkes** has been made assistant general manager of the tire division. **G. R. McNear**, formerly in the New York office, becomes factory manager of the Detroit tire plant, succeeding **C. L. Moody**, who has been named factory manager of one of the company's Canadian plants. **W. C. Manville** has been appointed manager of the field engineering and service department, succeeding **S. P. Thacher**, who recently was made chief of the rubber conservation section of the Army & Navy Munitions Board.

Harland F. Leathers, New York attorney, has been appointed chief legal counsel of the passenger automobile rationing branch of OPA. He recently has served as assistant chief counsel of the tire rationing branch.

A. W. Herrington, president of Marmon-Herrington, Inc., and president of the SAE, has been elected to a three-year term as a director of the American Society of Military Engineers.

Walter F. Wright, of Cleveland, has been named liaison officer between the Automotive Branch and Detroit regional offices of the War Production Board and the WPB office in Washington. Wright has been associated with the automotive industry since 1914, serving in an executive capacity with Willys-Overland, Graham-Paige and Houdaille-Hershey.

Frederick C. Horner, on leave as assistant to the chairman of General Motors Corp. on transportation matters, has resigned his position to give his full time to the office of chief of the Highway Transportation Division, Transportation Service, Services of Supply, of the War Department. He had been on leave of absence since last February.

Worthing H. Stone has been promoted to assistant advertising manager of The Timken Roller Bearing Co. and is to be in charge of advertising for the railroad, farm implement, automotive and rock bit divisions of the company. **S. L. Huffman** has been advanced to manager of the news bureau.

Howard M. Dawson, formerly of the Detroit office, is now in charge of the Export Department of the Jessop Steel Co., with headquarters in New York. **Fred Jessop Wood** has taken over Mr. Dawson's former duties.

Edwin C. Beck, service engineer for the Replacement Division, has been appointed Detroit representative for the Original Equipment Ring Division of the Sealed Power Corp.

Douglas B. Rader, designer and advertising consultant, has been named director of advertising for the Lindberg Engineering Co. He replaces **R. C. Onan**, who was made district sales manager in Milwaukee. **Robert S. Aitchison** of the advertising department has been appointed sales promotion manager.

Dan C. Hungerford has resigned as vice president and director of the Elastic Stop Nut Corp.

C. Grannis Bonner has been elected treasurer of Pomona Pump Co. He relieves **Donald C. McKenna**, vice president, and former treasurer, who will devote full time to the production activities of the company.

Ira J. Snader, division manager of the Republic Aircraft Products Division of The Aviation Corp., has been made vice president of manufacturing of the Corporation. He will be succeeded at Republic by **Sterling B. Withington**, formerly general manager of the Brunswick-Balke-Collender Co.

David G. Fleet, assistant general manager of Consolidated Aircraft, has been appointed executive vice president of Vultee Aircraft Inc.

P. E. Chance, general manager of the Brake Lining Manufacturers' Assn., Inc., was called by the U. S. Army to serve in the Motor Transport Corps. The affairs of the Association Office will be carried on by the secretary.

It Still Takes Repair Parts

(Continued from page 18)

tion will be made available for passenger tire use. If more than 75 per cent is released, or if expansion of projected capacities occurs, Thiokol can be substituted for the stated requirements of reclaimed rubber on the basis of 100 tons of Thiokol for each 80 tons of reclaim, and Butyl can be substituted in the ratio of 100 tons of Butyl for each 140 tons of reclaim.

In the reclaimed rubber tonnage of 97,420 long tons is included 30,000 long tons that has been allocated for recaps on the basis of the present ruling. A substantial amount of reclaimed rubber also would be made from old tires which the recipients of new tires would be required to turn in as scrap. Up to July 10, 1942, the tire companies estimate that 536,000 long tons of rubber scrap have been collected and that 747,000 long tons will be collectible during the next two years, making a total of 1,283,000 long tons. The annual reclaimed rubber plant capacity of the country is 350,000 long tons. With direct and indirect military and civilian requirements estimated to be from 282,000 to 305,000 long tons for the one-year period after July 1, 1942, the surplus plant capacity for the year ending June 30, 1943, would be 68,000 to 45,000 long tons of reclaimed rubber.

Due to the heavy demand for tires that has built up during the past few months, the present tire rationing procedure would have to be continued, but the plan would involve moderate changes in the present Class A and Class B groups, and all other car owners would be included in a new Class C group. This new class, representing almost 23,000,000 cars, would be able to get new or recapped tires made of reclaimed rubber or of such materials as Thiokol or Butyl, production of which is being increased. As at present, recapping would be compulsory for all applicants regardless of which group they fall in, except where old tires cannot be recapped and where no recapped tires or recappable carcasses are available for purchase. Separate ration quotas should be established monthly for classes A, B and C and certificates issued by the ration boards, the plan recommends.

CENSORED

An exclusive feature prepared by **M. W. BOURDON**, special correspondent of **AUTOMOTIVE and AVIATION INDUSTRIES** in Great Britain.

With innumerable cars now laid up for the duration of the war, and with recollection of trouble experienced after the last war, owing to the rusting and scaling of the inside of gasoline tanks of the comparatively few cars that had been out of use for two or three years, a nation-wide epidemic of this trouble is anticipated after the end of the present war unless some method or means of preventing it is conceived and applied.

The military authorities do not favor the use of producer gas as a fuel for Army trucks. They have investigated possibilities in this connection but in view of the "serious disadvantages compared with gasoline" it was decided not to adopt it, said Lord Croft, Under-Secretary of War, in answer to a question in Parliament.

Automobile insurance companies have agreed to make a 20 per cent reduction in premium rates for passenger cars during the remainder of the war period, in view of the reduced risk of accident owing to the greatly reduced number of vehicles on the roads, especially since the basic gasoline ration was withdrawn.

To secure more efficient production among sub-contractors on Government work, a great many small engineering firms hitherto operating independently are to be "concentrated." This implies, among other things, unified management, the better distribution of machine tools and skilled workers and, in many cases the merging of several undertakings under one roof. A survey has shown that at present 67 per cent of the engineering plants of the country employ fewer than 50 workers, while 30 per cent, including garages on war work, have fewer than 10 employees.

The London Passenger Transport Board (operators of London's buses and the Underground and District railroad systems) has arranged to equip 800 buses with producer gas plants, thereby saving 7 million gallons of gasoline per annum, it is estimated. The plant adopted is a trailer unit developed by chief engineer Morrison of the Eastern National Omnibus Co. Cylinder bores are being enlarged and compression ratio increased from 5:1 to 8:1; these alterations are said to reduce the power loss relative to gasoline from around 50 per cent to 30 per cent.

Under the new tire rationing scheme close watch will be kept to prevent tires, truck tires particularly, from being used "wastefully." What this means was explained by a Divisional Officer of the Ministry of Supply in a talk to truck operators. He said that operators who ran their tires to destruction and so made retreading impossible, and those whose records indicated persistent overloading, neglect of inflation pressure, misalignment of wheels and so on would run the risk of having their operating permit withdrawn and their vehicles requisitioned.

Material Shortages

(Continued from page 49)

the closing of the Chevrolet plant at Flint until Aug. 10 because of lack of steel and that tank and truck plants in the Detroit area may be forced to shut down because of the steel shortage. A former automotive plant making guns has had to curtail production for lack of steel. A machine gun factory has had to suspend operations in some departments on account of the tight steel situation, then run those departments overtime to catch up when the material arrived.

There is an important reason for the alloy steel shortage. From 7 per cent of the nation's steel production devoted to alloy steel in a normal year, the percentage will increase ultimately to 20 per cent of the nation's steel capacity under the stress of war-time output. In order to ease the material situation on such alloying elements as chromium, tungsten, nickel, vanadium and molybdenum, 16 N. E. (National Emergency) steels have been developed by metallurgists of the iron and steel industry. These N. E. steels are designed to achieve maximum utilization of the available alloying elements.

The armed services are developing substitutes to bring about the saving of critical materials. The Quartermaster Corps recently shifted the specifications on Army cargo truck bodies from steel to wood in order to effect an annual saving of 275,000 tons of steel. Half of the cargo truck bodies now are being made of wood and by September the conversion will be completed. This necessarily has made a change in productive facilities, with former manufacturers of auto trailers, store fixtures, furniture radio cabinets and refrigerators among the 50 subcontractors now producing truck bodies for the automotive companies that are prime contractors for army trucks.

In the tank production program, cast iron has been substituted in certain parts where there is low stress, with a resultant saving in cast steel.

Another shift in material, however, has increased the demands of war industry for steel. This was the recent announcement by Secretary of War Stimson that the War Dept. has approved the use of steel in place of brass in shell cases, following a year of experiments. This will conserve copper, which is vitally needed elsewhere in the war program. More than 30 manufacturers of artillery cartridge cases are now making the change-over. Buick Motor Division of General Motors is among the companies that will make steel shell cases. Capitalizing upon automotive experience in the deep drawing of steel, Buick has developed a method for drawing and heat treating the casings to insure

proper grain flow of the steel and produce the required yield and tensile strength.

To meet the huge demands of the war program for scrap metal, the Automotive Council for War Production has announced the first results of an industry-wide campaign to step up metal salvage in the automobile plants. In June the automotive plants shipped 101,900 tons of scrap to the mills, of which 97,500 tons were iron and steel. This does not include the scrap totals from companies like Ford which possess their own smelting facilities. About 10 per cent of the metal salvaged was in the form of obsolete tools, dies, machinery, and equipment. General Motors provided 40,631 tons of the scrap metal total from its 90 plants. Ferrous metals accounted for 95 per cent of that total. About 4200 tons of the iron and steel scrap came from discarded tools, dies, and machinery.

From past production of the automotive industry the steel mills are receiving even more scrap. This is in the form of junked automobiles. During June the automobile graveyard section of the WPB Conservation Branch produced 453,768 tons of scrap metal. This is more than 300,000 tons above the 1941 monthly average but it is not enough. An official of the WPB recently announced that the government would requisition from junk dealers automobiles which remain in disrepair for over 60 days.

Some of the biggest war-time users of steel are the tank manufacturers with their 12-, 14-, and 30-ton juggernauts. The Fisher Body Division of GM is now producing M-4 medium tanks in a new plant near Flint in train-load quantities. Ground for the plant only was broken last January. The first test model was turned out in 47 days in a former Fisher Body automotive plant but now the production is on a volume basis. The M-4, an all-welded model that is successor to the all-riveted M-3, has increased firepower and carries the 75-mm gun in a more maneuverable position in a turret that revolves a complete 360 degrees.

Chrysler Corp., the first automotive company to enter the manufacture of tanks, also has changed over to the 1943 (M-4) model of the medium tank. In announcing the change recently, E. J. Hunt, general manager of the government-owned arsenal, said that it originally had been planned to make almost the entire tank, except the engine, at the arsenal. But increased production schedules since Pearl Harbor have made it necessary to double the size of the arsenal and also to use more than 1 million sq ft of space in other Chrysler plants for making parts and subassemblies and the multi-bank power plants composed of five Chrysler automotive engines. Chrysler has 30 major war contracts, including bomber subassemblies, anti-aircraft guns,

Dodge army trucks, shell forgings, naval pontoons, airplane engines, and bullets.

Ford Motor Co., which has 22 major war contracts, will do an annual business of \$2 billion when it reaches its war peak, according to President Edsel Ford. Among the war products being made are tanks, fire control instruments, combat vehicles, tank engines, Pratt & Whitney airplane engines, jeeps, and, of course, bombers, which Ford compares to the production of automobile bodies.

With the current discussion about the feasibility of making huge flying boats for transport purposes in shipyards to be converted for the purpose, it may have been overlooked that Nash-Kelvinator Corp. already has contracted to make a similar type of aircraft for the Navy for cargo carrying. Nash is building a plant in New Orleans for this project, while parts and subassemblies will be made at Nash plants in Wisconsin and Michigan. The flying boat to be manufactured is practically a duplicate of the Excalibur, which was designed and built by Vought-Sikorsky at Bridgeport, Conn., for American Export Airlines to be used in transatlantic service. This plane is powered by four 1200-hp Pratt & Whitney engines and has a top speed of 235 mph.

Pig Iron Deficit

(Continued from page 52)

nances. The attitude of the War Production Board's Steel Branch is apparently that in recommending increased pig iron capacity they are dealing with knowable figures, while the extent of scrap that will be available is decidedly today's unknown quantity in calculating future steel supply.

In this connection it is interesting to note that uniform instructions covering the conservation and reclamation of all forms of industrial salvage are to be issued in the near future by a technical advisory board set up in the Industrial Salvage Section of the War Production Board.

The Office of Price Administration has authorized the Metals Reserve Company to sell new nickel anodes at a price not exceeding 46 cents per pound, f.o.b. present location of material. This is expected to make considerable frozen nickel available for the making of nickel steel as well as for nickel-plating of highest rated products.

Another Variety

Production of airplane parts from plastic bonded plywood soon will be added to the wartime work of the H. J. Heinz Co., Pittsburgh, Pa., prominent canners producing especially prepared rations for the armed forces.

Scrap Collection Nets Tons of Salvage

Automotive companies are cooperating with the War Production Board in the campaign for scrap metal salvage to keep the nation's blast furnaces and smelters in full operation during the war emergency. More than 350 companies had appointed salvage authorities by early July in the industry program launched June 15 under the direction of the Automotive Council for War Production and the Industrial Salvage Section of WPB.

Hudson Motor Car Co. recently consigned 300 tons of obsolete automotive machinery to the scrap heap. Hudson engineers made a survey of machinery on hand for which they had found no war-time use. Then they asked E. C. Brandt, chief of the machine tool section of the Automotive Branch, WPB, to look over this idle machinery for possible war use. Some of the machines were found useable for war jobs by other companies and Hudson arranged to sell the needed units to those com-

panies. The majority of the machines were found to be obsolete and non-convertible to war operation and these were scrapped.

Industrial plants in the Detroit area, including many automotive factories, sent 40,000 tons of scrap iron and steel back to the war production stockpile during May.

Studebaker employees participated in a company-wide scavenger hunt, placing a red tag on every piece of equipment whose value they questioned. Plant maintenance workers uncovered some abandoned pipe and hauled it to the scrap pile.

The first week's salvage operations yielded 578 tons of idle equipment which was hauled to two steel mills in 17 railroad cars. Also, Studebaker authorized one of its suppliers to scrap obsolete tools and dies, representing an initial investment of \$4,500,000, which accounted for 2000 tons of scrap iron and 500 tons of steel.

Pontiac Concentrates on Oerlikon Anti-Aircraft Guns

(Continued from page 24)

The grooves along the barrel, formerly cut in milling machines are produced by hobbing in the Cleveland Rigid-hobbers.

The rifling in the barrel is produced in the new American broaching machine which is provided with five separate broaching tools. The first of these is for corrective reaming, if required; the other four, for rifling. Rifle grooving is cut to a constant lead, controlled by a lead screw swiveling the first broaching tool as it moves through the barrel. The other broaches are left free to follow the pattern of the first tool. After the machining and engraving operations have been completed, the barrel is washed, sand-blasted all-over in Pangborn cabinets, then Parkerized in a special Parkerizing unit.

Ex-Cell-O thread grinders are employed for cutting the internal Acme thread on the breech casing end, from the solid, and the corresponding external thread on the end of the barrel. The thread has a pitch of 0.315 in. and is held to about 0.200 in. in depth.

Although the foregoing gives only brief comments on but two components, space limitations prevent us from covering much of the detail on the other parts produced here. Here, for example, is a group of heavy-duty Baker drills for opening up the bore of the case for the barrel spring from the solid forging. The core drill is about 3 3/16 in. in diameter. The breech bar is one of the major parts for which a separate machine line has been provided. This department includes W & S turret lathes, Heald internal grinders, and a large battery of P & W 6-in. vertical shapers. In all probability, no plant in the automotive industry has

featured as many of these shapers under one roof in peace-time activity. The breech bar also has a number of new three-spindle Cincinnati Hydro-Tels in the line-up of equipment.

Among the small parts is the trigger. It is of interest to find that the contour of the OD is ground to form in unique fashion in a Heald Size-Matic. The piece is held in a special fixture and is pivoted through its arc against the small grinding wheel to produce a perfectly contoured segment. Versatile Bridgeport vertical mills are used in large numbers in the machining of small parts. Too, there is a sizable bat-

same, which is an indication that none of the cylinders gets an excessive amount of oil. The practice of making oil consumption tests at different speeds is recommended as a check on accuracy of observation, because if an error is made, the observation point will not lie on a smooth curve. Deviations in the curve would be expected in the event of ring flutter, and the smoothness of the curves is evidence that the rings behave properly.

Oil scraper rings are made with a slightly conical bearing surface, so that they bear virtually only on one edge. How effective this scraping action of the ring may be was brought out in an example cited by Mr. Stahl. A production engine of about 500 cu. in. displacement showed wide variation in the consumption rate, and this was

tery of Gallmeyer & Livingston surface grinders for grinding small parts. One of the novelties developed here is the use of special hydraulic pump units for the clamping of fixtures used in holding small parts for fussy drilling operations on cylindrical pieces.

Black & Decker high-speed portable electric grinders are used for many delicate grinding operations on the breech end of the barrels, using "pencil" point grinding wheels for this purpose. A complete heat treating department is being placed in commission, including a battery of the familiar Lindberg draw furnaces.

The guns are completely assembled in the plant, including installation on the mounts.

Jap Zero Fighter

(Continued from page 19)

take-off and 900 hp at 15,000 ft. Other reports list a maximum horsepower of 1275. It is quite probable that both fabric and metal-covered models are now in use.

The maximum speed at a loaded weight of 5140 lb was first given as 315 mph at 10,000 ft; later releases credited the plane with a top speed of approximately 400 mph. The Zero is said to have a service ceiling of 36,000 ft and a range of 600 miles at 265 mph. Fitted with a streamline extra fuel tank, its range can be extended to 1600 miles at 160 mph. As an alternative, a 500-lb bomb can be carried in place of the spare tank.

The Zero's principal dimensions are: span—39 ft 5 in.; length—28 ft 5 in.; height—9 ft 0 in.; wing area—265 sq ft. An hydraulically-operated retractable landing gear and split flaps conform to modern design practices. Armament consists, purportedly, of two 7.7-mm machine guns firing through the propeller, and two 20-mm guns mounted in the wings.

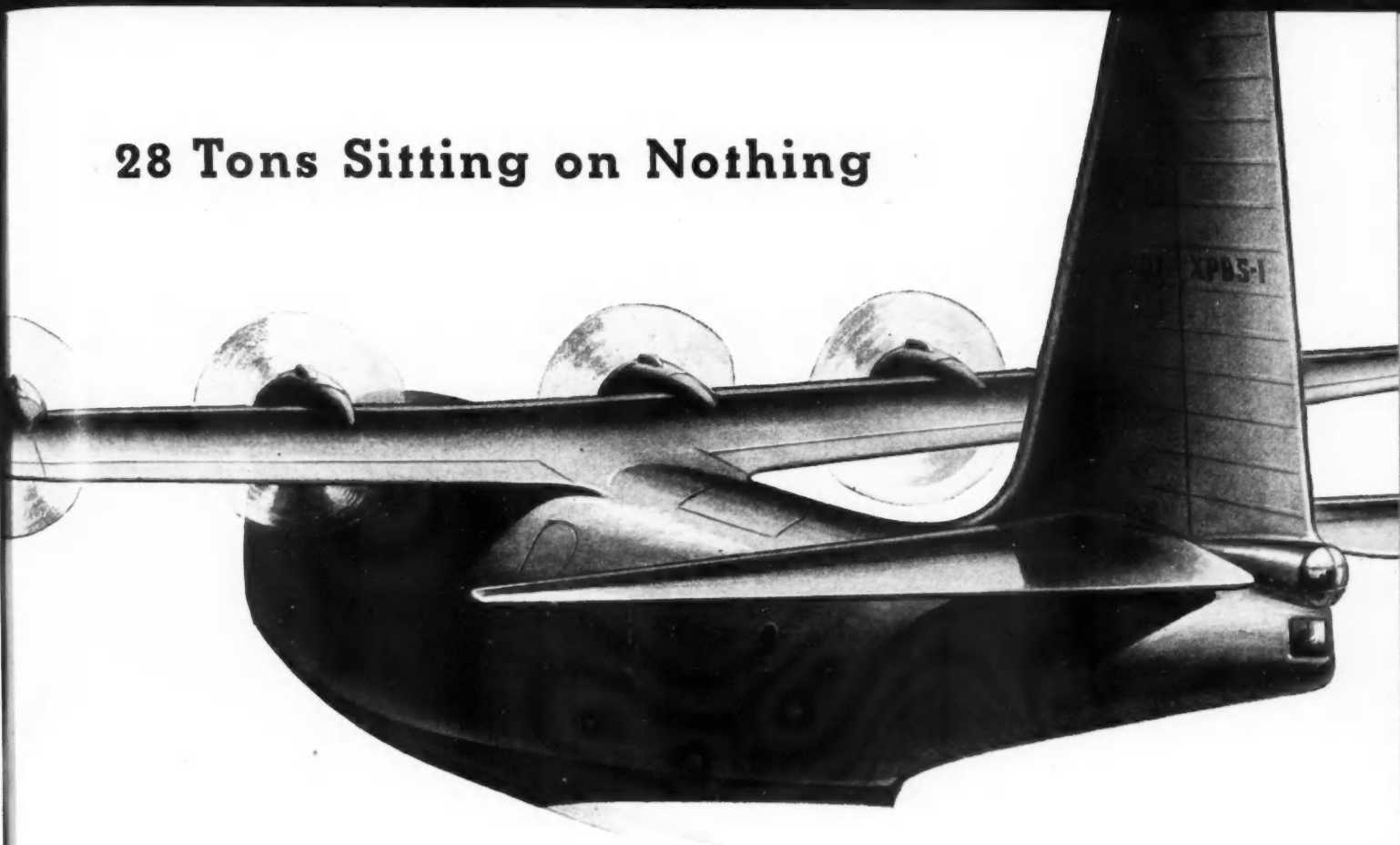
Diesel Engine Lubrication

(Continued from page 28)

thought to be due to a slight "out-of-squareness" of the compression rings. Following a standard 5 1/2-hr. break-in test, all of the compression rings were replaced so that any signs of hard bearing were at the lower edge. An oil-consumption test was then run, following which all of the compression rings were reversed in their grooves so that the hard bearing was at the upper edge. It was found that with the hard-bearing edge down, the consumption was 0.130 lb. per hr., whereas with it up the consumption was 0.694 lb. per hr. The "out-of-squareness" was very small compared to the 3/4 or one deg. taper used in conventional tapered compression rings.

The object of the oil control ring is to limit the amount of oil delivered to the compression rings so as to just prevent scuffing. Compression rings do

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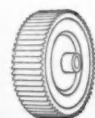
All this meant new manufacturing techniques—new production methods. American manufacturers may look forward with confidence to the application of these developments to peacetime speed reducers and gears to assure better machines—quieter machines—produced at lower cost.

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not operate under full-film lubrication; if the oil ring passed sufficient oil to insure full-film lubrication of the compression rings, the oil consumption would be intolerably high. Of the compression rings the topmost one operates under the most difficult conditions. It was pointed out by Macy O. Teetor, of The Perfect Circle Co., that this ring operates in that part of the cylinder which is at the highest temperature and is distorted most; that it, under the greatest pressure, receives the least lubricant, and is blasted with any dust that enters the intake. Undoubtedly a great many cases of trouble

from excessive oil consumption are brought to manufacturers of piston rings as the most likely to find a satisfactory cure, and Mr. Teetor mentioned one such case in which an engine of 220 hp. at 2200 r.p.m. consumed a gallon of oil for 407 bhp.-hr. In spite of this high oil consumption there was evidence of considerable scuffing on both pistons and rings. By changes in the piston-ring practice and in the liner and piston materials the oil consumption was reduced to one gal. per 739 bhp.-hrs. Changes made in the ring arrangement were as follows: Cast iron to alloyed cast iron, keystone

section to rectangular section, smooth surface to thread-finish Ferroxx surface; top ring, 3/16-in. SAE wall to 3/32-in. K wall; second, 3/16-in. to 1/8-in.; third, 3/16-in. to 1/8-in.; fourth, more unit wall pressure in slotted oil ring; fifth, slotted oil ring to plain ring. At the same time the cylinder liners were changed from SAE 4140 steel to cast steel, and the pistons from untreated virgin aluminum to secondary aluminum anodized. Changes were made also in the shape of the piston skirt and the clearances of the skirt and lands.

A number of the speakers at the symposium mentioned the use of chromium plating for piston rings. This seems to be the latest method of specially preparing the wearing surface of rings, following the use of bronze inserts, oxidized, phosphorized and tinned surfaces. J. O. Holls and T. C. Jarrett of American Hammered Piston Ring spoke very highly of this treatment for piston rings, claiming that it reduces cylinder wear, increases the life of the rings, and reduces friction between the rings and the cylinder bore. Mr. McLaurin of Guiberson Diesel Engine Co. referred to the use of chrome-plate rings in the top groove and claimed that such rings have the advantage that they do not lose their elastic force. He said that when all of the three compression rings are of the chrome-plated type there is a slight increase in the oil-consumption, but the present scarcity of chrome-plated rings discourages this practice.

Acetylene Generators Save Swiss Cars

(Continued from page 25)

sists of one volume of acetylene gas to 12.5 volumes of air. The difference between the maximum engine outputs with gasoline and acetylene undoubtedly is due chiefly to the difference in the densities of gasoline vapor and acetylene. The former is about five times as dense as the latter and occupies only about 1.5 per cent of the volume of the mixture, instead of 7.5 per cent. Therefore, less air can be drawn into the cylinder per cycle when acetylene is mixed with it in the proper proportion than when it is mixed with gasoline vapor, and less fuel can be burned.

Another Swiss acetylene generator for motor car propulsion is known as the "Buss," and in the illustration it is shown mounted on the rear of a Mercedes-Benz car with an engine of 140 cu. in. displacement. A handle for starting purposes is shown on the left side. This equipment gives the car a radius of action of about 100 miles on one charge of calcium carbide.

Calcium carbide, a product of the electric furnace, can be most economically produced in countries where electric power is cheap owing to the abundance of water power, such as Switzerland and Southeastern France.

MEMORANDUM

To Production Executives:

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Patriotic volunteer committees of executives are already hard at work on this problem in 421 industrial centers.

The Industrial Section of the Conservation Division has a corps of technical advisers who are prepared to work with all types of industries.

A thoroughgoing Salvage program in a factory can not only help meet

the present emergency, but can help prepare that factory for its postwar operations through the elimination of once wasteful practices.

- 1 The first thing to do is to put some one individual in charge of Salvage in all departments of your business and give him not only the responsibility to act, but the authority to act.
- 2 The next thing to do is to get in touch with your local Industrial Salvage Committee and map out a detailed program with the materials and ideas that are available. Their program contains 17 simple steps.

If in any doubt, write or wire at once to the Conservation Division, War Production Board, Railroad Retirement Building, Washington, D. C.

This job is being tackled by a democratic nation through the volunteer efforts and initiative of democratically managed industrial concerns, rather than through directives or compulsion as it is done in Axis countries.

Every executive, every superintendent, every foreman and every worker in every plant can help.

The main thing is to get started now.



All unusable material, equipment, and stocks should be scrapped at once and put back into war production. Please read this message and act now.

D. M. Nelson

D. M. NELSON, CHAIRMAN, WAR PRODUCTION BOARD

This message approved by Conservation Division

WAR PRODUCTION BOARD

This advertisement paid for by the American Industries Salvage Committee (representing and with funds provided by a group of leading industrial concerns).

SCRAP FROM HOMES AND FARMS—As individuals, search your home from attic to basement. Search your garage. Look at the old familiar things in a new light. Do you need them—or can you get along without them? Your country needs every pound of scrap iron and steel, other metals, rubber, rags and burlap to provide the fighting materials our armed forces must have. Take your scrap to the nearest Salvage Depot—give it to a charity—or sell it to a Junk dealer. . . . If you live on a farm, consult your County War Board or your farm implement dealer. In any case, your scrap will flow back into the blood stream of our war production.

Alternate Motor Fuels

(Continued from page 44)

of plant, works out to about 7 cents for the equivalent of 1 gal. of gasoline.

Sewage gas is compressed into cylinders exactly as described in the case of town gas. The equipment is identical with that used with coal gas, but owing to the higher calorific value of the gas, a wider range can be covered, or a reduced number of cylinders employed.

One local authority in the London

area has fitted a number of its vehicles with four gas cylinders, each of which holds 330 cu. ft. of gas at a working pressure of 3000 lb. per sq. in. The gas is reduced to 10 lb. pressure in the first-stage reducing valve, and to slightly under atmospheric in the second valve. An automatic mixer is fitted to the engine intake manifold, and driving is similar to running on gasoline. In order to obtain efficient performance,

the compression ratio of the engine was raised to 8:1.

The performance on sewage gas is excellent, and the system has much to recommend it to local councils and towns which employ the activated-sludge process.

Liquefaction of sewage gas is under active consideration, and may prove the most desirable method of utilization.

Other Gases

The gases propane, butane and isobutane are available to a limited extent in Britain, as by-products of the hydrogenation of coal to oil. Excellent results are obtained with these gases as motor fuel, but they are used mainly for cooking and lighting in boats, houses, bungalows, etc., in out-of-the-way places.

Liquid Fuels

The chief liquid substitute for gasoline is creosote oil, obtained by the distillation of coal tar, and it is used in both spark-ignition and compression-ignition engines.

With spark-ignition engines a special type of carburetor is employed, consisting of two carburetors built as one unit, and operating through a central atomizing device. A hot-air intake is fitted to the oil side, and an automatic spring control ensures that when the engine is idling it is running on gasoline. A two-way movement of the accelerator pedal controls the carburetors. By lifting the pedal with the toe, the gasoline carburetor is brought into operation, while the normal downward movement cuts off the gasoline and brings the special oil into use. The system depends upon effective atomization rather than vaporizing. The power is excellent, and best results are obtained in long-distance work. Before being placed on the market, the oil is washed with caustic soda and re-distilled, and it has a specific gravity of 0.92. When using this fuel, careful attention must be given to the spark plugs. After each trip the engine must be run on gasoline a short time before it is switched off, to avoid wet plugs and ensure easy starting. The special carburetor costs about \$100 and is easy to install.

With compression-ignition engines, creosote oil is not a very satisfactory fuel when used alone. Four types of creosote are available, and are distinguished according to the tar from which they are produced, namely, (a) vertical gas works, (b) horizontal gas works, (c) coke ovens, (d) blast furnaces. The difference, from an engine-fuel point of view, is one of naphthalene content, the first, and last-named tars giving creosote with the least quantity of that hydrocarbon. Gumming and sludge formation are rather troublesome when using ordinary creosote, owing to the presence of tar acids, and it is now the usual practice to wash the oil with caustic soda before use. Oil with high naphthalene content also



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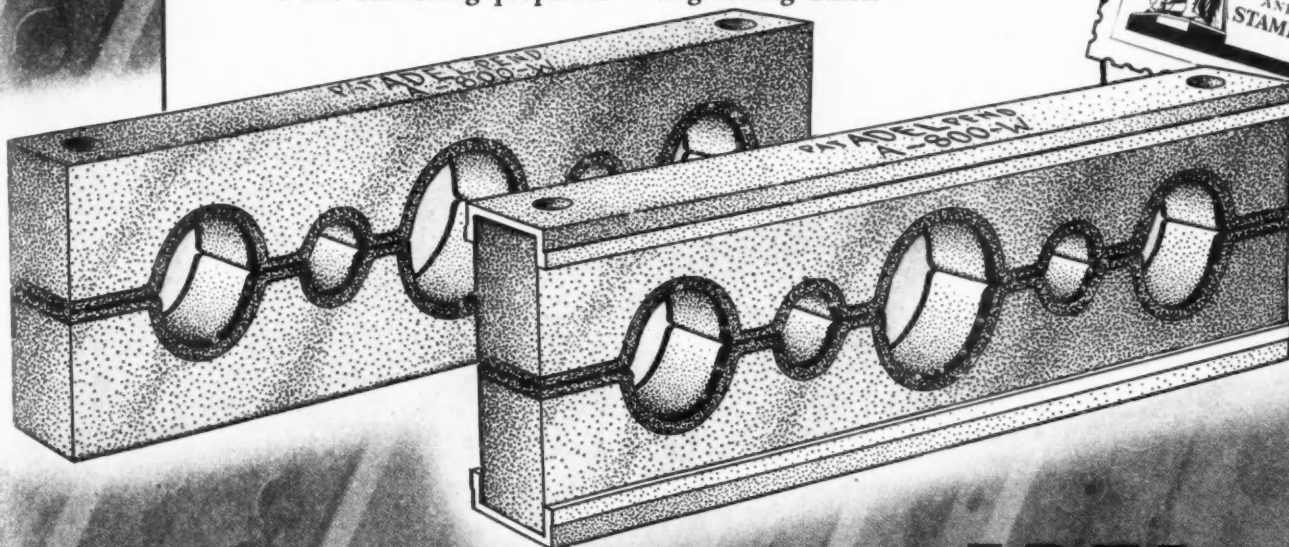
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Due to the critical synthetic rubber shortage, ADEL plastic supports have been revived to "pinch-hit" for the duration. Called the Victory Series A 800-W, these supports are strictly interchangeable with the 2,000 types and sizes now in production thus saving invaluable engineering and shop time for aircraft manufacturers.

While cushioning properties

are frankly not as good as the ADEL A 800-A Series, these supports present savings of approximately 88% of synthetic rubber plus savings of aluminum and other critical materials while affording reasonably dependable service for many installations.

Of course, ADEL A 800-A supports using Adelite cushioning material are still available for installations demanding a maximum of vibration absorption combined with dependable, fool-proof support for severe military service requirements. Design and Production Engineers connected with recognized armament industries may obtain new coding information and catalog pages by contacting nearest ADEL Engineering Office.



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must be well cooled and filtered before it is washed with soda. It is the practice to mix the washed creosote oil with gas oil or the usual diesel fuel before use, and while some concerns have used 50/50 mixtures, the best results are obtained from 70-75 per cent of petroleum oil, and 25-30 per cent of washed creosote. With such a mixture no difficulties in engine operation are encountered, and in one town more than 30 buses use mixed oil and maintain about 90 per cent of their pre-war mileage.

Steam and Electricity

Two other methods of transport must

be mentioned, namely, the steam trucks and the battery electric vehicle.

In 1914 there were three excellent types of steam truck available in Britain, and progress was made in the design of this type of machine until 1933, when a number of improvements were introduced. The steam vehicle available was a 12-ton, six-wheeler, with double-acting engine, shaft drive, pneumatic tires, and a boiler working at 250 lb. per sq. in. This vehicle covered about 29 miles to 1 cwt. of coal, and 25 miles to 1 cwt. of coke. In 1934 the steam truck was practically driven off the road by taxation, and in addition, there never had been sufficient

market to make it possible for research and experiment to be carried on at a reasonable level, with the result that it was not possible to produce vehicles which could compete with the gasoline vehicle, and which had made continuous progress with increased efficiency.*

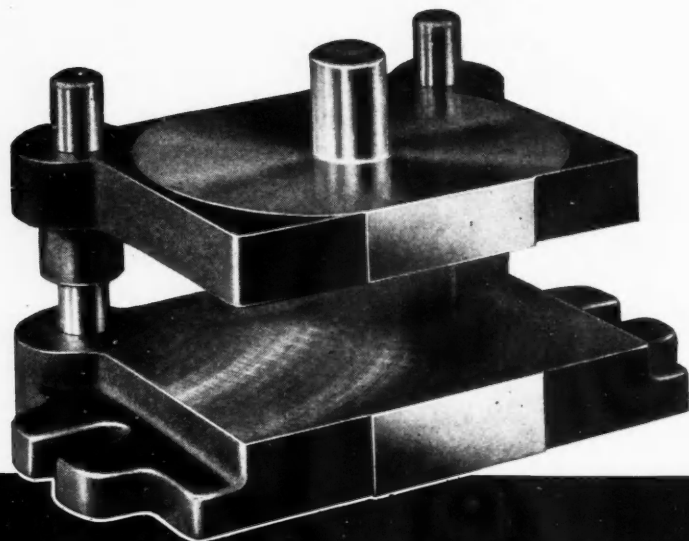
Many old steam trucks now have been resuscitated, have taken their place once again in the transport system, and are playing a very useful part. It may be that the steam truck will stage a comeback after the war, for if the present knowledge of steam generation and utilization is applied to vehicle design, a truck could be produced which would be well able to compete with the gasoline-operated internal-combustion engine.

A large number of transport operators also have turned their attention to the battery electric vehicle. Two forms of electrically operated vehicle are used in Britain, namely, the trolley bus and the battery truck or van. The former draws its power from the mains through overhead lines; its sphere of operation is confined to well defined routes, and it is, therefore, used chiefly to replace existing trams and motor bus services. The performance of the trolley bus is excellent, and operating costs are low, but this method of transport naturally is confined to the public-service-vehicle operators.

The battery vehicle used in Britain is usually of the 1500-lb. and 3000-lb. class, but some 6000-8000-lb. trucks and vans are employed by local authorities in refuse collection. The batteries used are of the lead acid type, but a number of the alkaline class also are employed. The latter have a longer life, but while they are also lighter, they take up more space for the same watt-hour capacity. The small battery vehicle is limited in operating range to about 30-40 miles, and to a speed of 15-20 m.p.h. The duties for which it is suited are schedule delivery work with numerous stops for the delivery or picking up of goods, for distributing merchandise to depots, and delivery of goods to railhead. High speed is not essential for this work, but the high acceleration of the electric vehicle is a decided advantage in present-day traffic streams. The battery vehicle is free from starting-up troubles, and its limited mileage is not important, because the vehicle is employed on work with which considerable time is spent at rest. Operators find that the running costs are lower than those of a gasoline vehicle of the same capacity, but standing charges are slightly higher, due to battery depreciation.

The battery vehicle is playing a useful part in the transport scheme, and is well employed in milk delivery services, bread and confectionery delivery, laundry transport, and refuse collection duties.

* The advent of the Diesel engine in the truck field during the early thirties undoubtedly had a good deal to do with the demise of the steam truck.—Editor.

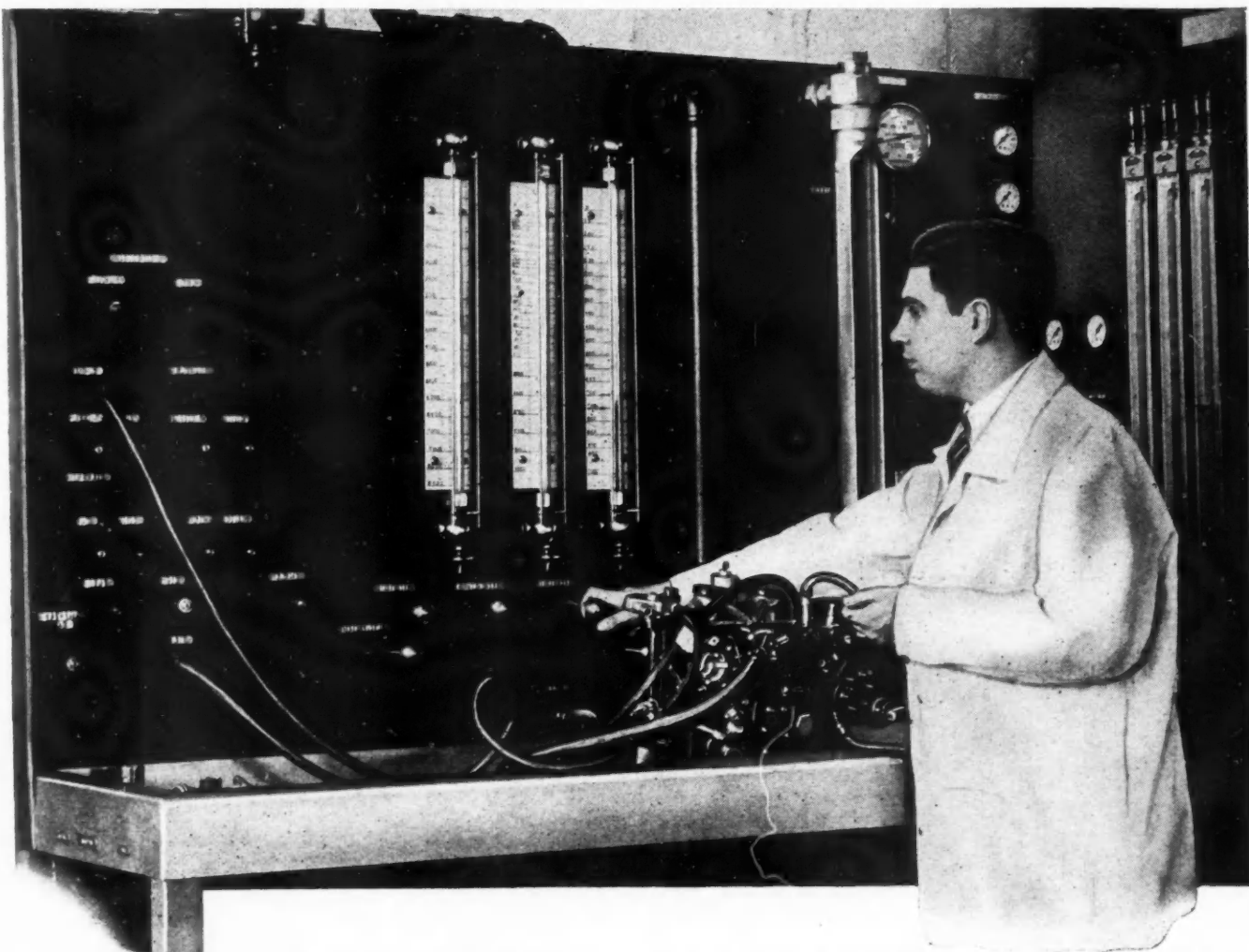


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condition that will be encountered in service use. The performance of the carburetor can be accurately checked and any necessary adjustments can be made on the bench, with the result that when the test is completed the carburetor is in 100% perfect adjustment to operate the engine at maximum efficiency as soon as installed.

Such test facilities, plus precision manufacturing methods, explain why the Stromberg Injection Carburetor flies with so many of our fighting pilots as a member of "The Invisible Crew."

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August 1, 1942

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79



Detroit miracle

In Detroit they used to make automobiles. They had production lines that would bring 15,000 separate pieces together and roll them off in one piece—a completed car every twenty seconds. They had giant machines that would ream an 8-cylinder engine block in a single operation. They had dies from which bodies and fenders could be stamped out like cookies on a dough board. They made automobiles faster, cheaper, better than anywhere else in the world.

Then, overnight, the picture changed. Cars were out and a large share of total American war production was suddenly planked down in the laps of the men of Detroit.

A lot of people wondered if Detroit could do it. It had been common practice in the automotive industry to start work a year or more in advance, simply to bring out a new car model. It would take nothing short of a miracle, people thought, to scrap those gigantic intricately-planned production lines and substitute a new and unfamiliar war-production set-up.

Detroit pitched in.

Draftsmen spreadeagled over huge drafting boards, detailing plans of the mammoth new plants. Engineers by the thousands labored over endless stacks of blueprints. Machine tools, delicate and precise as fine watches, rugged and sturdy as battleships, were brought in and set in their appointed positions. Production flow sheets were planned and replanned until parts came together smoothly, quickly, efficiently.

Then Detroit began to roll.

The jeeps and the peeps and the tanks and the planes and the guns and the shells and the motors and the bombs began to come off production lines in a steady stream. Bofors and Oerlikon anti-aircraft guns, Hispano Suiza cannon, Browning machine guns. Allison and Wright and Pratt-Whitney motors. Giant bombers that fly to Europe in 400 minutes. Diesel engines for submarines and ships. Little tanks and medium tanks and big tanks. Today, less than a year since car production was halted, they've accomplished a miracle of production in Detroit.

America owes a great debt to the brains and the guts and the sweat of the men of the automotive industry. They've done a job—a job that America can be proud of and thankful for. We at Bethlehem have been, and are, supplying Detroit with steels for tanks, guns, shells, engines, planes, trucks and many other machines of war. We are doing everything in our power to see that those steels are as nearly perfect as steel-making science can make them. There has been a miracle at Detroit. We are proud to have had a part in it.



Morale-Building Activities for War Workers

(Continued from page 33)

ployes can win merit awards that entitle them to wear special pins. These can be earned by making an acceptable suggestion on production or factory methods, doing a particularly fine job at some task or contributing commendable cartoons, posters or war slogans.

Departmental boards of review, composed of two members from supervision, two from the labor ranks and a member of the top "Work to Win" committee, decide on the merit award winners every two weeks. The aircraft worker earns a double wings award, similar

to a flier's wings. Award winners also have their names inscribed on a special honor roll posted on the bulletin board.

In addition to the individual incentives for achievement, there are departmental awards. Departments beating the government production schedules are given "Work to Win" citations in the form of rayon banners for production merit. Departments failing to meet their production quotas are given cheap canvas banners inscribed "Now behind the eight ball but next week? ? ?" to hang overhead. Departmental production scoreboards also are displayed giving the department's record on the basis of efficiency, schedule and cost of scrap. Another chart for plant bulletin boards records the efficiency of the various departments on a monthly basis, showing where each department ranks in relation to the entire plant. Each section of the plant also contains a company-wide production score-board which shows the average weekly output in the previous month, the previous week's output and the current week's goal. Various size engines rather than actual figures are used to illustrate these totals, the numerical totals being regarded as confidential military or naval information. The engine representing the current week's goal is just an outline but this is filled in daily in relation to the day's output of engines. Thus the employees can see where the company stands on the current week's work.

To further dramatize the production schedules, glass-encased miniature battlefields have been placed inside factory entrances to show the progress of the four major plant divisions in comparison with monthly production goals. Toy soldiers occupy these miniature battlefields and they are moved forward each week in relation to the division's weekly output. Information booths have been located in various parts of the plant, with someone on duty every shift to answer questions about the "Work to Win" program.

Another aspect of the program is a "Work to Win" Training School in which apprentice machine operators are trained, inspectors are taught their duties, foremen are instructed, workers are upgraded and job texts created. A six-week training period for the apprentices is followed by four weeks of on-the-job training. If the apprentice then proves himself qualified, he is given a regular production job in the plant. Packard also has a suggestion contest which gives awards to workers for suggestions on better ways to use tools or machines, and to effect savings of time, money or materials in the production of armaments.

Through these extensive campaigns the automotive companies hope to stimulate the productive efficiency of their employees so that the high production goals set by the armed services can be met and the weapons and armaments delivered on time where they will do the most good.



DETREX MEN know how to analyze your metal cleaning requirements . . . to show the men in your production departments how machines can be operated most efficiently and economically . . . to recommend how solvents can be saved . . . and to cooperate on every phase of your metal cleaning processes.

Ever since Detrex products were first introduced, the men who have represented this company have always been thoroughly experienced in every phase of metal cleaning. Their "follow-through" has been continuous wherever Detrex machines and chemicals are used.

With today's new metal cleaning problems and demands for faster, more efficient production, Detrex Service can be of greater help to you than ever before. No obligation, of course.



SOLVENT DEGREASING and ALKALI CLEANING


DETROIT REX PRODUCTS COMPANY

13001 HILLVIEW AVENUE • DETROIT, MICHIGAN

Branch Offices in Principal Cities of U. S. A. — In Canada, Canadian Hanson & Van Winkle Co., Ltd., Toronto, Ontario

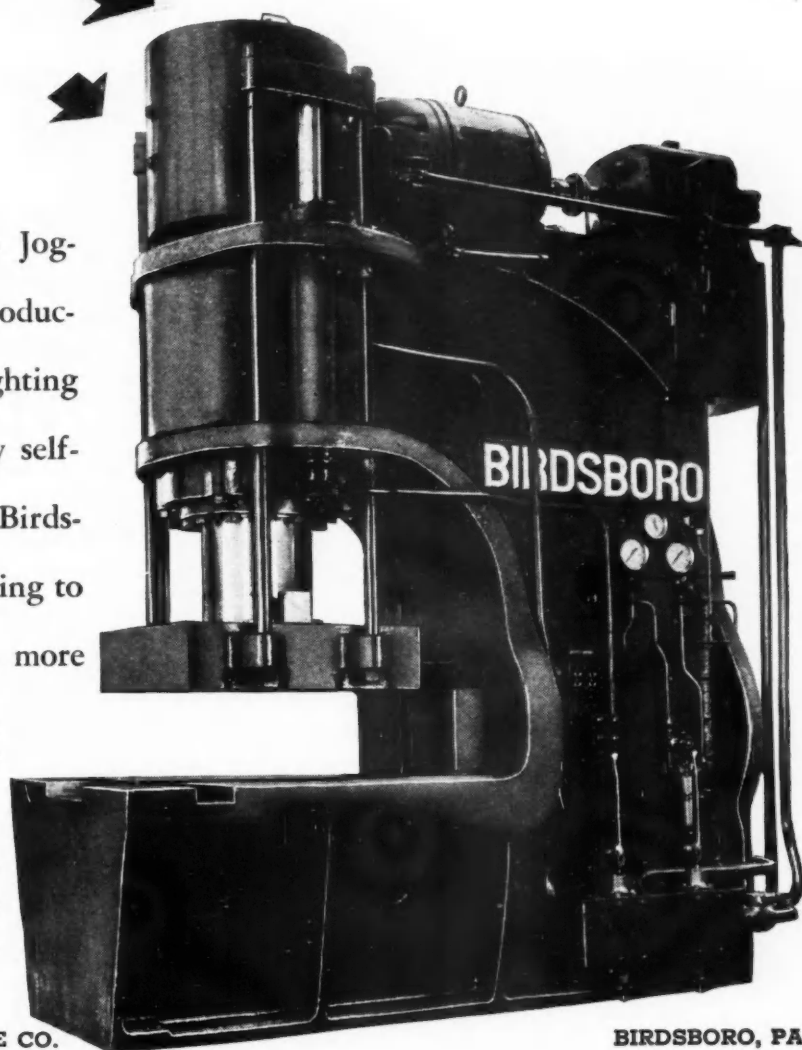


builds bigger convoys... faster!



This 350-ton Birdsboro Jogging Press is "in the Navy now," producing ships that keep our overseas fighting men well supplied. This completely self-contained unit is typical of many Birdsboro Hydraulic Presses that are helping to provide the United Nations with more ships, more tanks and more planes.

Birdsboro's Hydraulic Engineers will be glad to work with you, to provide the press to meet your specific requirements.



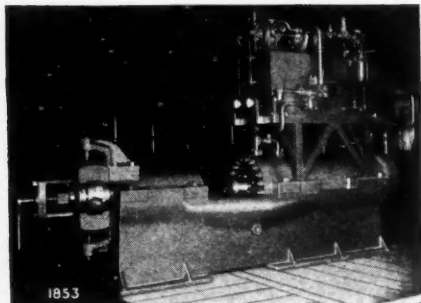
BIRDSBORO STEEL FOUNDRY & MACHINE CO.

BIRDSBORO, PA.

BIRDSBORO
HYDRAULIC PRESSES

MEN and MACHINES

(Continued from page 48)



plete press is designed to give a working pressure of 10,000 psi.

The hydraulic pumping equipment, including pumps, relief and control valves, oil reservoir, and pressure gage are mounted directly above the main cylinder where they cannot be damaged by floor conveyances. A manual adjustment within easy reach of the operator

Beatty Model 100 Hydraulic Extruding Press.



**BUY
DEFENSE BONDS AND STAMPS**



**... AND LONGER LASTING
AETNA BALL BEARINGS**

★ Remember the wiser you buy the more you help to conserve labor and materials that are indispensable to a nation at war—to **VICTORY!**

Long-lived, dependable AETNA PRODUCTS mean less frequent replacements, increased production and extended machine life. You save for yourself, for your country.

AETNA BALL BEARING MFG. CO.

4600 Schubert Ave., Chicago

Thrust Ball Bearings (Standard and Special) . . . Angular Contact Ball Bearings
. . . Roller Bearings (Special) . . . Ball Retainers . . . Hardened and Ground Washers



gives pressure and velocity changes as required.

The material cylinders on the standard press are 50 in. long, although the machine is arranged to accommodate a 72-in. cylinder.

A NEW-TYPE reversible electric motor designed for the operation of aircraft antenna reels is offered by the



This small motor, type LD3R, built by the Signal Electric Mfg. Co., is especially designed to drive aircraft at antenna reels.

Signal Electric Mfg. Co., Menominee, Mich. Equipped with ball bearings, the motor is wound to operate on either 12 or 24 volts and to deliver 1/13 hp at 8500 rpm.

THE CLARK TRUCTRACTOR DIVISION of Clark Equipment Co., Battle Creek, Mich., for more than 20 years a builder of gas-powered industrial trucks, is now making trucks with full electric equipment for storage battery power.

Through the use of an hydraulic vane-type pump driven by a series



THE DEEPFREEZE Santocel low temperature metal chiller, manufactured by Motor Products Corp., North Chicago, Ill., is offered in two sizes. Frequently used in the assembling of tight-fitting metal parts, the unit is also recommended for the sub-zero tempering and stabilization of high-speed tool steels. By use of this unit temperatures below -120 F can be attained.

Greenlee

AUTOMATIC NEWS

PREPARED BY GREENLEE BROS. & CO., ROCKFORD, ILL.

PRODUCTION OF BOLT SPEEDED UP BY USE OF FORM TURNING ATTACHMENT

Greenlee 1½" Automatic Turns Out 36 Parts Per Hour

Today the manufacturer using automatic screw machines in the production of the vital munition parts needed for our war effort, can be sure of getting maximum production from his machines by using only the most efficient tooling set up possible for each particular job.

This story of the production, on a 1½" Six-spindle Greenlee Automatic Screw Machine, of a connecting rod bolt for an airplane engine, is an excellent example of planning the most efficient tooling to obtain the greatest production possible.

Form Turning Attachment For Turning Long Length

The problem encountered in the production of this connecting rod bolt was that of turning a long length in as few positions as possible to obtain the maximum production. To solve this production problem, a form turning attachment was used which permitted the part to be completely rough turned in two positions and still maintain the short stroke of 1½ inches necessary to get a production of 36 pieces per hour.

If the form turning attachment had not been incorporated in the tooling set-up for this part, the production would have been considerably less than it was, since a longer tool slide stroke would have been required to permit the rough and finish turning operations that the finish of this part required.

Production Time Cycle 100 Seconds

The production time cycle for this connecting rod bolt, made from 11/16" square A.M.S. 6310 steel is 100 seconds, or 36 per

hour. The spindle speed is 166 R.P.M., resulting in 42 S.F.M. The tool slide feed is .0042 inches per revolution.

Sequence of Operations

In the first position the stock is broken down for the form turning operation, and the thread diameter is rough turned with the roller turner.

In the second position the square section is turned with the form turning attachment, the thread diameter is finish turned, and the end is faced.

In the third position the piece is rough formed under the head, the .365 front bearing diameter is finish turned, and the end is chamfered for the thread.

In the fourth position the relief section in back of the thread and the tapered section of the front bearing diameter is formed. The second relief diameter and the second bearing diameter are rough turned in this position with a knee turner ahead of the roller support. The piece is supported on the previously turned thread diameter.

In the fifth position the piece is faced under the head, and the rear bearing diameter and the rear relief diameter are formed. The piece is again supported on the previously turned thread diameter.

In the sixth position the piece is supported and then cut off.

TO HELP YOU

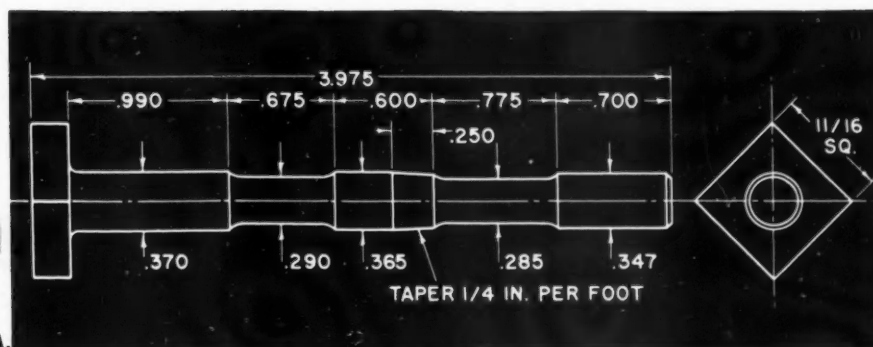
Greenlee Bros. & Co. hopes that the performance data and production stories of jobs now being run on Greenlee Machines presented in these advertisements will be of some help to the metal-working industry in obtaining more efficient screw machine production.



Shown above is a view of the set-up for the production of this part, showing the first, second, and third positions. The photograph was taken just after the machine was indexed and does not show completed operations at the various positions. The form turning attachment described in this story is shown in the second position.



The photograph shown here was taken from the rear of the machine and shows the tooling set-up for this job in the fourth, fifth, and sixth positions.



Greenlee
BROS. & CO.
ROCKFORD ILLINOIS U.S.A.

MULTIPLE-SPINDLE DRILLING, BORING, AND TAPPING MACHINES • AUTOMATIC SCREW MACHINES • AIRCRAFT PRODUCTION MACHINERY



Clark electrically-driven industrial truck.

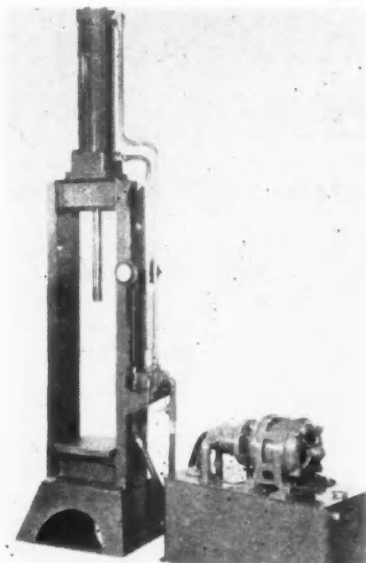
wound motor, the machines lift from 2000 to 7000 lb. The same pump oper-

ates the tilting unit which enables the operator to tilt the load back 10 deg in 5 sec for safe riding, and to tilt it forward 3 deg in 1 sec for tiering. The machine has four speeds forward and four reverse; maximum speed is 6 mph loaded and 7.5 mph empty. The trucks can climb a 7½ per cent grade under their maximum loads. A General Electric motor powers the front-wheel drive; the steering mechanism is connected to the rear wheels.

Standard equipment includes hydraulic brakes, centrally located control levers, spring-mounted, rubber-cushioned seats, disk-type wheels, and an electric horn. Although motors and

electrical equipment are supplied by General Electric, the customer has his choice of an Edison alkaline battery or any standard make of acid battery.

ANOTHER all-welded hydraulic press has been announced by Hydraulic Machinery, Inc., Detroit, Mich. Operated by a 7½-hp motor, the press exerts a maximum pressure of 25 tons. The ram is driven through a 30-in.

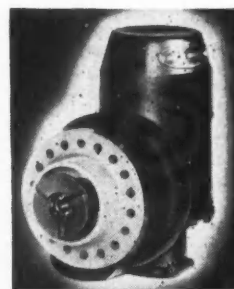


Although it is designed for a specific use in war production, this new hydraulic press, built by Hydraulic Machinery, Inc., has many other industrial applications.

stroke at a closing speed of 4.4 in. per sec, a high-pressure speed of 0.8 in. per sec, and an opening speed of 5 in. per sec.

The hydraulic power unit, although it is shown adjacent to the press, may be installed at a more remote location.

ANEW line of direct-cranking electric starters has been announced by Champion Aviation Products Co., Los Angeles, Cal. They are designed for aircraft engines delivering up to 400 hp, tanks, landing barges, etc. Model No. 1200, weighing 18 lb, is



This new Champion aircraft engine starter incorporates an improved safety clutch.



INSTALL A WELLS METAL CUTTING BAND SAW

Today's all-out war program, calls for close efficiency in cost and consumed time in production. A WELLS METAL CUTTING BAND SAW has solved the problem in thousands of plants. A rugged, accurate Wells saw, with its many features and flexibility, is a real asset to your plant.

Write for further details.

SPECIFICATIONS

WELLS No. 8

Capacity: Rectangle 8" x 16"
(spec. bowed guides) 5" x 24"
Rounds 8" dia.
Speeds: ft. per min. 60, 90, 130
Motor Specifications optional

WELLS No. 5

Capacity: Rectangle 5" x 10"
(spec. bowed guides) 5" dia.
Speeds: ft. per min. 40, 90, 130
Motor Specifications optional



WELLS MANUFACTURING CORPORATION • Three Rivers, Michigan

A large stock of blades is available at all times

WELLS METAL CUTTING BAND SAWS

POWER...and still more POWER for the Navy



These reduction gear units—important links between motor and propeller in naval vessels—are made of Cast Steel.

Steel Castings are used for this purpose for a very sound reason—they are the quickest and least costly way of securing the strength, the stamina, the precision and the wearing qualities needed for this vital job.

It is significant that the maker of these parts has just been asked to quadruple his output!

There are no adequate substitutes for Steel

Castings in thousands of applications—for both armament and peacetime goods—no other materials that do the work quite so well, or that can be turned out so quickly at such low cost.

Should you find it difficult to get steel castings when you need them, it is because they have so many important jobs to do, and are in such great demand.

But you'll find your steel foundryman a resourceful man, anxious to help solve your problem. Or you may write to Steel Founders' Society, 920 Midland Building, Cleveland, Ohio.

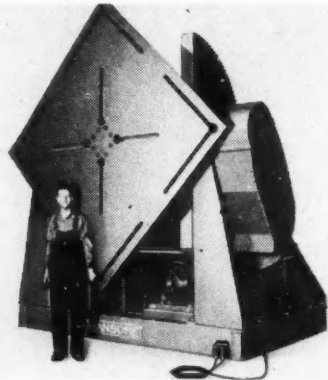
MODERNIZE AND IMPROVE YOUR PRODUCT WITH

STEEL CASTINGS

recommended for small airplane engines; Model No. 1300, weighing less than 20 lb, is suited to cranking some 400-hp engines. The compact design includes an improved safety clutch patents for which are pending.

THE INDUSTRIAL Division, Ransome Concrete Machinery Co., Dunellen,

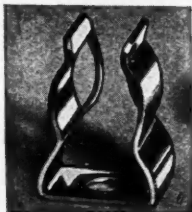
Built by the Ransome Concrete Machinery Co., this 20-ton welding positioner will find many uses in production.



N. J., has announced the addition of a 20-ton-capacity heavy-duty unit to its line of standard welding positioners.

The 84-in.-square work table is well reinforced and is fitted with four radial and four L-shaped T slots. It can be not only rotated about its center through a full 360 deg, but also swung about its horizontal axis into a vertical position when tilted in one direction and into a 45-deg position when tilted in the other. Both movements may be accomplished simultaneously since separate driving motors are provided. Timken bearings are used at many vital points in the machine.

New! Amazing Achievement!



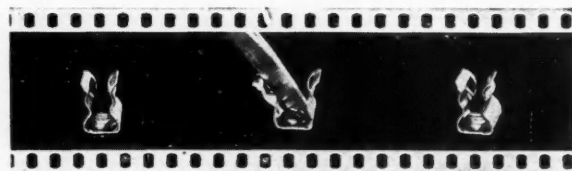
Littelfuse Be. Cu. Fuse Clips especially designed for Aircraft, and other uses of most severe stresses. Spring quality of steel.

**IN
FUSE CLIP
FATIGUE RESISTANCE!**

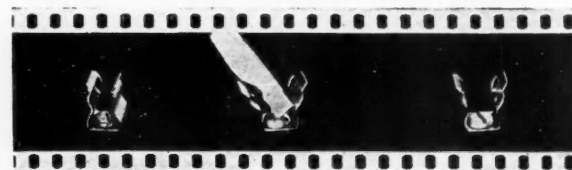
Now Available in

**LITTELFUSE
Beryllium Copper Fuse Clips**

It enables these clips to withstand severest, longest vibration—shows greater tensile strength, and resistance to heat and corrosion. Three times the grip of best phosphor bronze!



← Movie photo shows Littelfuse Be. Cu. Fuse Clip subjected to screw driver test. **OBSERVE INSTANT RETURN TO ORIGINAL FORM** in end picture. Spring quality of steel.



← Same test of Phosphor Bronze Clip. Note spread that remains in clip in end picture.

Littelfuse Be. Cu. Fuse Clips are especially designed for Aircraft and other uses where stresses are a high factor. Hundreds of thousands delivered to Aircraft Plants, Commercial Airlines, Army and Navy. Ask for special Be. Cu. Clip folder.

Send for Complete Catalog. We make fuses for all aircraft purposes—high and low voltage—instrument, radio, automobile and auto radio fuses—mountings, panels, Tattelite Pocket Electrical Tester, etc. Write today.

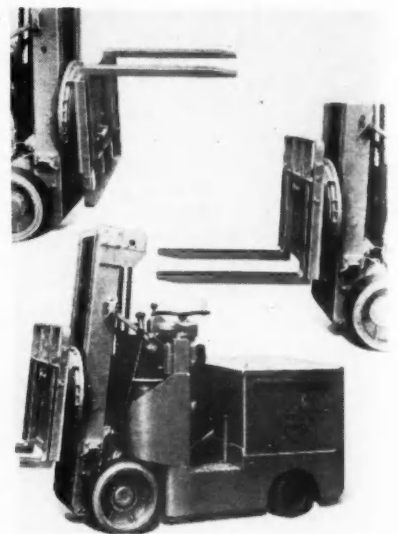


LITTELFUSE INC.

"First in Aircraft Fuses — Pioneer in the Industry"

4731 RAVENSWOOD AVE., CHICAGO, ILLINOIS
201 ONG ST., EL MONTE (LOS ANGELES SUBURB), CALIF.

EQUIPPED with rotating forks to increase its usefulness, the Elwell-Parker center control truck, Type F-23T, built by the Elwell-Parker Electric Co., Cleveland, Ohio, can travel at a maximum speed of 5 mph under full load and handle loads weighing up to

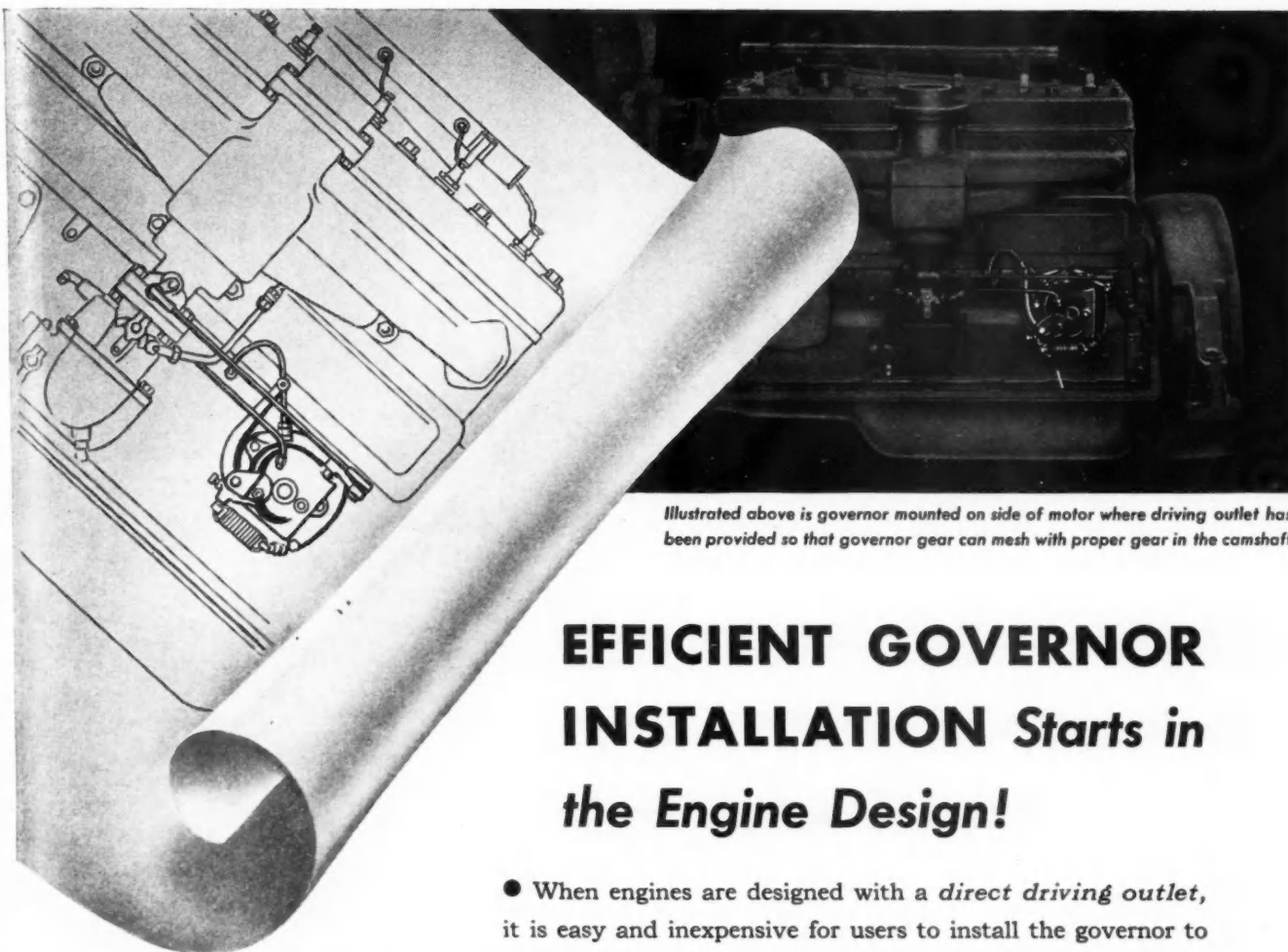


Elwell-Parker center control electric truck fitted with forks mounted on a rotating base.

4000 lb. The forks can be rotated through a full revolution, although the rotating base can be provided with stops to limit the swing to any angle up to 180 deg. This electric-powered truck is said to be quite useful for extra high tiering. The tilting uprights which are 83 in. high when telescoped can be extended to 140 in. For handling roll paper, the forks are interchangeable with a rotating apron.

LATEST application of the "Easy" electrically driven portable reciprocating sander, made by the Detroit Surfacing Machine Co., Detroit, Mich., is on a variety of airplane elements including propeller blades. Speed and accuracy are claimed as prime advantages of this versatile tool which has been adopted in plants producing all types of war products where sanding, rubbing, and polishing are required.

The Model XL, which operates with



Illustrated above is governor mounted on side of motor where driving outlet has been provided so that governor gear can mesh with proper gear in the camshaft

EFFICIENT GOVERNOR INSTALLATION *Starts in* *the Engine Design!*

● When engines are designed with a *direct driving outlet*, it is easy and inexpensive for users to install the governor to operate efficiently—assuring the positive, accurate, dependable control that's needed!

This is more than ever a vital consideration in planning engines that will sell when peace comes again. Your customers, then, will demand motors designed for efficient governor installation, because they are learning today the necessity for protecting power units against destructive over-speed, as well as close speed control in many operations.

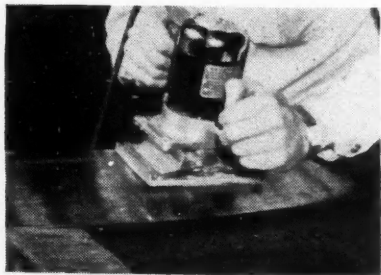
The time to give your engines of tomorrow this important sales advantage is *right now*—when you are designing them. There are a number of convenient ways of providing an efficient governor driving-outlet. Pierce engineers will be glad to talk with you about governing, and add their wide experience to yours in solving this problem.

THE PIERCE GOVERNOR COMPANY, 1637 OHIO AVE., ANDERSON, INDIANA



Pierce Governors

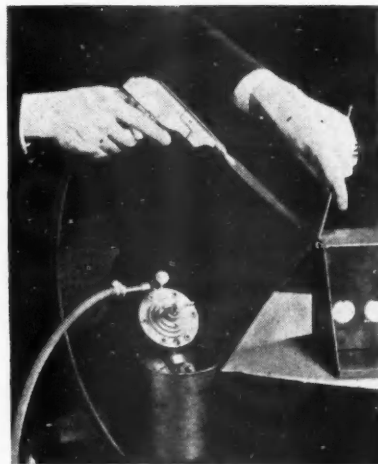
STANDARD SINCE 1913



Speed and accuracy are claimed for the "Easy" hand sander built by the Detroit Surfacing Machine Co.

a reciprocating motion is provided with means for adequate cooling through an improved design which permits an ample flow of air through the motor.

THE GAS GUN, an automatic acetylene torch which looks like a pistol, is being introduced to Pacific Coast war industries by the Gas Gun Co., Inc., Salem, Ore. Offered as a handy tool for use in soldering, brazing, etc., the gun is fitted with a gas-igniting mechanism similar to that found in a cigarette lighter. Measuring 6½ in. long by 5½ in. high, the gun weighs only 20 ounces.



This new Gas Gun, an automatic acetylene torch introduced by the Gas Gun Co., Inc., is especially useful in soldering, brazing, and lead burning.



• • • Unequalled SURFACE SMOOTHNESS and SPHERICITY

The series of lapping operations performed as a matter of course in the Stroom plant give Stroom Steel Balls a degree of surface smoothness and sphericity that has always been unequalled in any other regular grade of ball. Only through such unique lapping practice can extreme precision be obtained.

Physical soundness, correct hardness, size accuracy, and sphericity are guaranteed unconditionally in all Stroom Balls.

Other types of balls—*stainless steel, monel, brass and bronze*—are also available in all standard sizes. Write for catalog and prices.

Stroom

STEEL BALL CO.

1850 So. 54th Avenue, Cicero, Ill.

The largest independent and exclusive Metal Ball Manufacturer

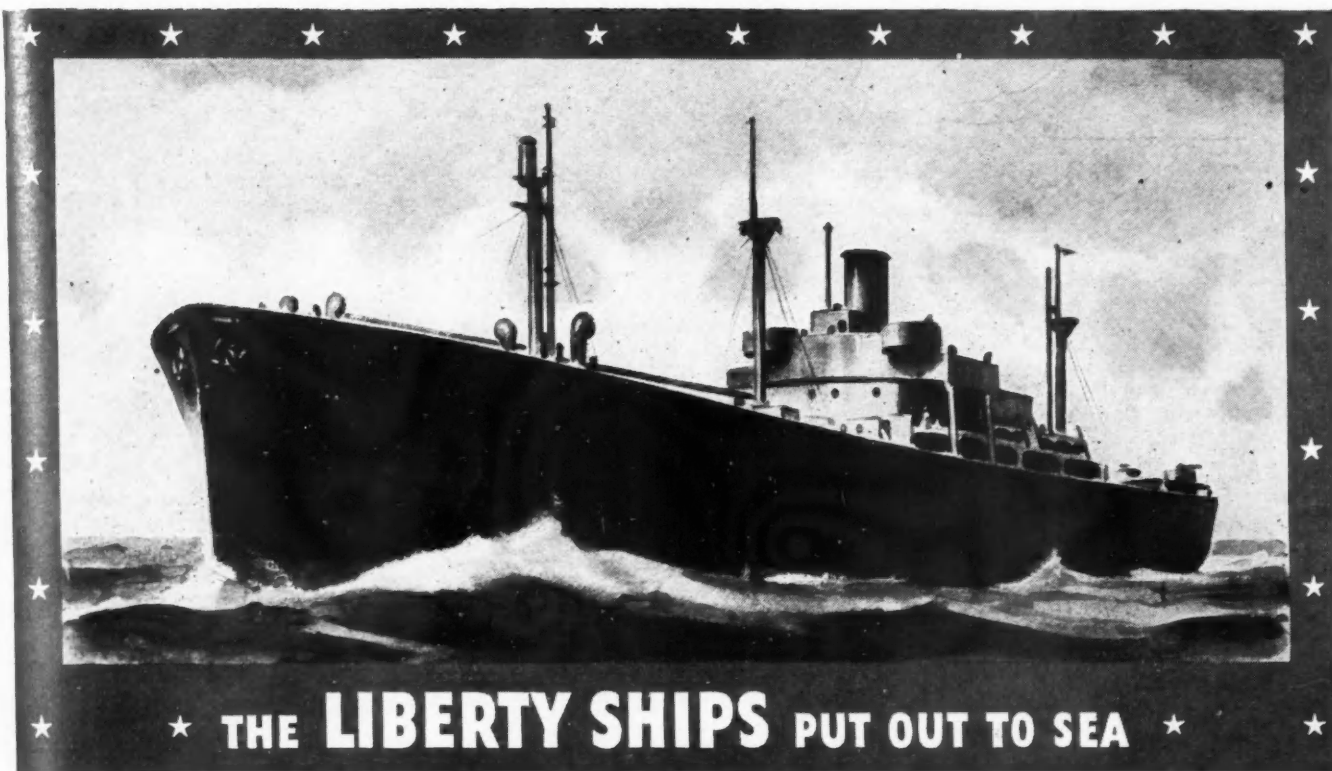
VIBRATION measurements, essential to the production of first-line equipment, can be made quickly and accurately with Model 11-A Vibrometer, manufactured by Televiso Products, Inc., Chicago, Ill. Consisting of two major parts, an indicating instrument and a search prod, the device is capable of measuring vibration displacement, velocity, and acceleration. It operates on 110 volts, 50-60 cycles, and responds to frequencies ranging from approximately 8 to 2500 cycles per second.

The instrument itself is a vacuum



The Vibrometer, manufactured by Televiso Products Inc., provides an accurate means for the measurement of vibration.

tube voltmeter incorporating a heavy D'Arsonval movement which is actuated by a 6-tube circuit connected to a piezoelectric Rochelle salt crystal contained in the test prod. Thus by setting the instrument for the required type of measurement and applying the search prod to the part under test, it is possible to read directly the displacement in inches, the velocity in inches per second, or the acceleration in inches per second per second.



★ **THE LIBERTY SHIPS** PUT OUT TO SEA ★



THE LIBERTY SHIPS of the Victory Fleet are slipping down the ways in ever increasing numbers and putting out to sea. They are carrying planes and guns and supplies to our far-flung battle bases. The majority of these are powered with Famous Hamilton Engines. The story of these engines is an epic of modern mass production on an unprecedented scale.

The Famous Hamilton Engine Shops played a vital part in the World War of 1917. Today's performance is just one more instance in which Hamilton Engines have been delivered in quantities, on time, when they were most sorely needed.

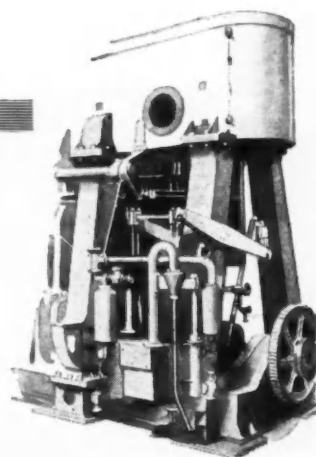
**GENERAL MACHINERY
CORPORATION**

HAMILTON, OHIO

THE NILES TOOL WORKS CO.

THE HOOVEN, OWENS, RENTSCHLER CO.

GENERAL MACHINERY ORDNANCE CORPORATION



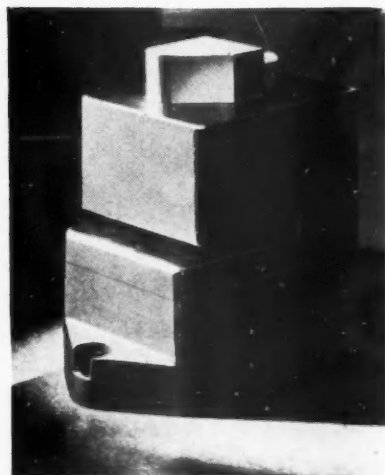


New type of window made by Monsanto Chemical Co. can be fastened to a wooden frame with an automatic stapler.

A NEW type of window pane, developed by the Plastics Division of Monsanto Chemical Co., Springfield, Mass., is produced by the lamination of transparent plastic and wire mesh. Tested under vacuum conditions the pane is said to have withstood, without appreciable damage, a 28-in. vacuum; glass tested in a similar manner shattered upon the application of a 15-in. vacuum. During another test, the material was unharmed by the explosion of a 150-lb bomb 8 ft away.

The new material consists of standard 16-mesh wire screening sandwiched between two sheets of Vuelite, a trans-

parent cellulose acetate sheeting originally developed for fluorescent lighting fixtures. Although it can be drawn or formed to almost any desired shape, the new material is manufactured in panels of eight standard sizes ranging from 9½ in. square to 19½ by 24 in. The standard panels are drawn with a ¼-in. flange which can be quickly fastened to wood sash with an automatic stapler.



Wales notching die for cutting clearances in aircraft bulkheads.

A NEW Wales notching unit for notching aircraft bulkhead clearances has been added to the Wales line by The Strippit Corp., Buffalo, N. Y. Since no part of the punch is connected to the press ram, the punch can be shifted easily from one position to an-

"Alligators"
JOIN THE MARINES

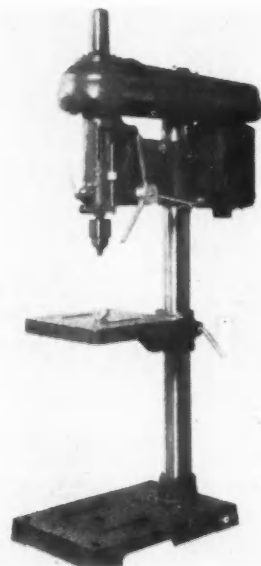
Nicknamed "Alligators" the versatile new Marine Corps tractors can travel over deep water, swim wide rivers, cross swamps . . . as well as roll like a tank on land. These fighting amphibians are designed for starting action in leatherneck landings.

Sure-fire starting action, is engineered into each "Alligator" engine . . . the BENDIX Drive. With the "Alligators," the BENDIX Drive broadens its war service, carrying over a peace-time record for starting action in more than 60 million engines.

The BENDIX Drive is a vital member of "The Invisible Crew"—all the precision-built equipment made by the 15 BENDIX Divisions—on war duty with our fighting crews on every front.

THE INVISIBLE CREW
PRECISION EQUIPMENT BY **Bendix**
AVIATION CORPORATION

ECLIPSE MACHINE DIVISION
Elmira, N. Y.



Several improvements have been added to the Taylor Model F400 "Hi-Duty" drilling machine. These improvements consist primarily of a completely-enclosed belt drive, a heavier depth-of-cut gage, a new-type spindle drive lever, and new spindle drive bearings.

MOTOR TOOL

Ball and Roller Bearing

LIVE CENTERS

Take the Brake
off Production—
HERE!

Dead centers put a needless brake on your machines—and your production—because of FRICTION.

Friction builds up excessive heat—burns out—breaks down—the center.

With MOTOR TOOL LIVE CENTERS friction is reduced to a minimum.

These Centers revolve with the work on both ball and roller bearings—spin along on job after job—steadily, smoothly, silently, speedily—with only occasional time out for redressing the point.

Try this superior Center on your toughest piece of work. Note how COOL it keeps at high speeds—and the absence of chatter.

In the long run—with MOTOR TOOL LIVE CENTERS—you can be sure of both service and savings.

THE CENTER
OF
ATTRACTION

FEATURES

Simple Design . . . Heavy Duty . . .
Greater Radial and Thrust Load Carrying Capacity . . . Large Spindle . . .
Small Head . . . Short Overhang . . .
Locking Feature for Redressing Point without Disassembling . . . Oil Seal Lubricant Retainer . . . Compensation for Expansion of Metal.

MOTOR TOOL MANUFACTURING CO.

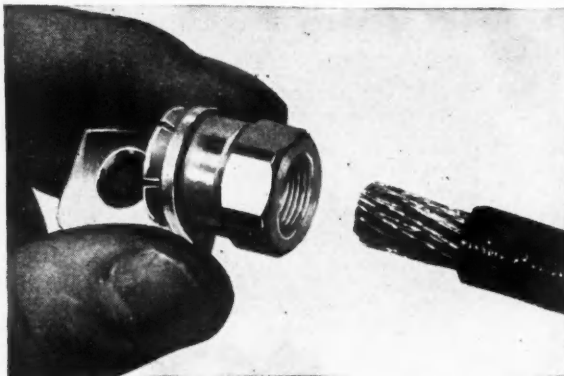
METAL CUTTING TOOLS

7775 CORTLAND AVENUE • DETROIT, MICHIGAN

Make it a Rule
to Call Motor Tool

other. A group of these dies may be arranged in the press by applying a template to the cutter blocks which extend through the heads of the dies.

TO MEET the need for even more thorough bearing care, the Ahlberg Bearing Co., Chicago, Ill., is distributing an adaptation of a production type bearing washer which is said to permit thorough washing and drying. The unit weighs only 10 lb and handles a full range of bearing sizes. An additional unit for repacking clean bearings provides the means for forcing lubricant through cleaned bearings without waste.



Aircraft Marine Products, Inc., Elizabeth, N. J., has developed a new light-weight cable lug for three wire sizes—Nos. 2, 0, and 00. The lug, consisting of three simple parts is fastened to the wire by applying a wrench to a hexagon nut which contracts a collet about the strands. It is made of tinned copper.

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AUTOMOBILE TOPICS
March 2, 1916

Our Present and Immediate Task

is to maintain the supremacy of the air—acrobatics for ourselves and our Allies must be turned out at top speed.

WYMAN-GORDON Aeroplane Crankshafts



are doing their share in making Perfect, Safe and Sure the driving power of these aerial scouts of the army.

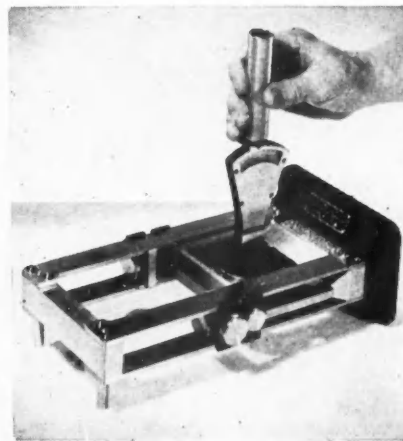
All the artistry and every device of the Master Forger, developed in over a third of a century making crankshafts for Automobile and other high speed engines, is concentrated in the production of these vital parts of the

This advertisement (left) published nearly a quarter of a century ago is as true today as when it appeared. Wyman-Gordon's production was then as now, all for war. Vital forgings, then and now. Two hundred eighty-four Wyman-Gordon forgings in this modern bomber, every one laboratory controlled from bar steel to finished product.



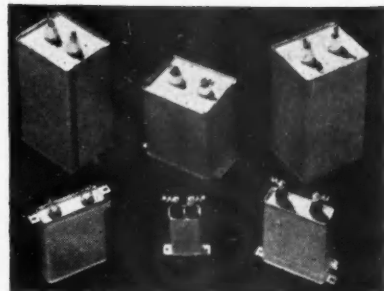
WYMAN-GORDON
Guaranteed Forgings
WORCESTER, MASS. HARVEY, ILL. DETROIT, MICH.

DESIGNED to eliminate the slower method of setting instruments and gages with clamps, and parallels with gage blocks, the Ellstrom internal setting gage, marketed by the Detroit Gage Co., Dearborn, Mich., is said to incorporate gage surfaces finished to



This model of the Ellstrom internal setting gage will cover readings up to 6 inches; other models can be made for any reasonable range.

millionths of an inch in flatness. Constructed of fine steel, the gage is quickly and easily adjusted by the use of two thumb screws on each riser. It is 12 in. high overall and has a base of 4 by 6½ in.



These capacitors are representative of the complete line of oil, wax, electrolytic, and motor-starting capacitors manufactured by the Industrial Condenser Co., Chicago, Ill. The company is equipped to produce on special order many condensers which are not carried in its regular line.